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ENGINEERING AND MINING JOURNAL-PRESS

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The Mount Isa Silver-Lead Field

Australia's Newest Find

A. W. Newberry, mining engineer, who has just returned from the Cloncurry district in northwestern Queensland, describes the mineral area at Mount Isa which was found in March a year ago. Surface showings and the shallow prospecting work done thus far offer considerable promise. The author also tells of his visit to the unique cobalt mine near Selwyn.

Marketing Sodium Nitrate

By Charles H. MacDowell

President, Armour Fertilizer Works

Metallurgical History of the California Rand

By Murray N. Colman

Metallurgist, California Rand Silver, Inc.

Biography of F. W. Harbord

Past President, Institution of Mining and Metallurgy

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ENGINEERING AND
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JOSIAH EDWARD SPURR, Editor

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South African Gold Mining and Politics

LOOKING FORWARD to the elections in the Union of South Africa, the Gold Producers' Committee of the Transvaal Chamber of Mines has issued a pamphlet explaining the economic situation of gold mining and its relation to the political programs. This is a remarkably clear and terse summary, which places squarely before the political leaders the facts concerning gold mining in South Africa and, irrespective of politics, points out the effect various "reform" measures would have on this important industry.

The general tenor of the pamphlet, which is a conservative "business statement," is, "Leave us alone." It is interesting to note this attitude, at the present time, when the gold miners of the United States are seeking strenuously to find something that the government can do to help them. South African gold miners are chiefly animated by the apprehension that the government will meddle. "To the farmer struggling with unfavorable world conditions," the pamphlet concludes, "to the commercial man and the trader, the most essential need at the present time is not the adoption by the government of fantastic schemes, promising everything but certainty, but the steady return of economic prosperity."

One of the problems discussed is that of native labor. The Labor Party urges immigration restrictions, "the stopping of the importation of cheap uncivilized labor." This is aimed against the employment of natives from Portuguese territory and favors exclusive use of presumably "civilized" natives of the Union and from such territories as Basutoland, Swaziland, and Bechuanaland. The pamphlet points out that the exclusion of the natives from Portuguese territory would result in a labor shortage, the rise of wages, and the closing down of mines which are now running on a narrow margin. The Nationalist Party, on the other hand, is committed to a policy which involves the gradual withdrawal of the natives from the mines and other industries and the corresponding increase of European labor. Such a policy, the Gold Committee points out, would have the same ultimate effect as the policy of the Labor Party. Both these policies, it is pointed out by the committee, rest upon a revival of the old and discredited theory that it is possible to work the mines solely by European labor, a theory which has been investigated and rejected by several commissions and investigation boards. The idea which is at the bottom of these political plans is that because the gold mines in Canada and Australia are worked by Europeans only, the same can be done on the Witwatersrand; but it is pointed out by the committee that under this plan gold mining in Australia is rapidly declining, the number of Europeans employed having fallen from 70,000 in 1901 to 11,000 at present. European miners in the Rand receive £1 per day.

Another political scheme involves the establishment of a State Industrial Bank, "for the purpose of assisting industries in the same way as the Land Bank helps agriculture." All the political parties—the South African Party, the Labor Party and the Nationalist Party—are committed to a State Bank in one form or another. Moreover, the Nationalist Party believes that the mining industry should be compelled to sell its gold in South Africa, presumably to the State Bank. Upon this question the Gold Committee patiently explains the well-known marketing conditions which favor South African gold mining—how they sell their gold for United States dollars at $20.67 per ounce, and with the dollars purchase British sterling and South African sterling at their present depreciated figure, giving them an exchange profit, or "premium," of about 10 per cent. The mines which are operating on a margin of less than a 10 per cent profit have an annual output of more than £5,000,000 and a European payroll of over 3,500 persons; and all these would have to close if their gold had to be marketed at home.

The subject of taxation is another vital question discussed. The political parties evidently are ambitious to tax the mines more highly, or at least the most profitable mines, spurred on by a popular fallacy that gold mining is plain treasure digging and as such ought to be heavily taxed. But the taxes, the committee points out, are already higher than in Canada.

Altogether, it would seem true that the gold-mining industry of South Africa—a very vital industry for the British Empire to conserve—is indeed more in danger of ignorant political tampering than it is in need of special legislation.

The "Pittsburgh Plus" Decision

FOR SOME YEARS the custom of the steel industry in selling its products at the Pittsburgh base price plus freight to consuming points has been a bone of contention between the U. S. Steel Corporation and certain independent producers on one side and most of the outlying consumers and certain other independent producers on the other side. The situation was succinctly set forth editorially in these columns Dec. 27, 1919, and has not changed since so far as arguments for and against are concerned. Efforts were made some years ago to have the Federal Trade Commission take up the matter: at first, the commission decided that it did not have jurisdiction; then its personnel changed, and the new members decided that the Pittsburgh plus practice was a fit subject for investigation. A protest of the Western Association of Rolled Steel Consumers was accordingly acted upon, and it was decided, by a vote of three to two, that the practice be allowed to continue, as was reported in our issue of July 31, 1920. Now, exactly four years later, and with a still different personnel, the commission decides, by a vote of four to one, that it has jurisdiction, and that the practice is unfair and must be abandoned by the Steel Corporation and others who uphold the plan. On the basis of this very evident difference of opinion, it is altogether likely

that the matter will come to a long fight in the courts.

As we have pointed out before, the Pittsburgh plus basis has very evident faults, and yet has a good economic foundation to support it. No such generally accepted principle holds in the non-ferrous metal trade, and yet one paragraph of the commission's recent decision would change the practice of most any metal seller. It is this:

The Steel Corporation and subsidiaries must cease "from selling or contracting for the sale of or invoicing such steel products in the course of interstate commerce without clearly and distinctly indicating in such sales, or upon such contracts or invoices, how much is charged for such steel products f.o.b. the producing or shipping point, and how much is charged for the actual transportation of said products, if any, from such producing or shipping point to destination."

Now, it is the general custom in selling copper and lead to quote a delivered price with no mention made of the cost of the transportation from refinery to consumer. In fact, even the cost itself is considerably clouded by the fact that a good part of the copper sold in the East is entitled to a refining-in-transit freight rate, and it is a matter of bookkeeping whether the refiner or the consumer gets the benefit of the location of the refinery.

In general, competition and the cost of transportation to the consumer's plant govern the price that the non-ferrous metal consumer must pay. The conditions that exist in the steel industry could not obtain, because there is no dominant interest responsible for one-half or more of the total production, as is the U. S. Steel Corporation.

Mount Isa

DISCOVERY of an extensive mineralized area is always interesting, wherever it may be. A few years ago it was Keno Hill, in the Canadian Yukon, that invited and richly repaid exploration with its lead-silver ore. Then Elbow Lake, in northern Manitoba, proved a disappointment to the gold seekers, and, more recently, the Rouyn district, in Quebec, has been rather carefully examined, though decisive results have not yet been announced. More remote than any of these is the Mount Isa field, in Queensland, where in an area of two square miles numerous outcrops of lead-silver ore have been found since the first discovery in March, 1923. Mount Isa, the eminence from which the district takes its name, is only 100 ft. above the sea and is about 200 miles south of Cloncurry, where the Mount Elliott mine is situated. An engineer of New York, Mr. A. W. Newberry, has only recently returned from a visit to this region, and the article by him on pages 165 to 171 of this issue gives his impressions and appraisal of the new discovery. He is rather optimistic.

There appears to be no doubt about the surface showings at Mount Isa. Whether the ore continues and can be profitably worked at depth is the important question, to answer which it seems hardly sufficient work has yet been done. At the time of Mr. Newberry's visit, there were sixteen prospect shafts from 12 to 80 ft. deep, totaling about 520 ft.; nine inclines 15 to 53 ft. deep, in all about 250 ft.; one adit 22 ft. long, and a large number of cross-trenches and open cuts. The limited tonnage shipped from these workings up to Jan. 1 averaged 64 per cent lead and 55 oz. silver per ton. The ore should be easy to treat, says Mr. Newberry.

Some will hesitate to classify Mount Isa as a second Broken Hill or Cœur d'Alene on the strength of prospecting work described above. To Mr. Newberry it seems well within the realm of probability that the metallic content of the lodes should persist without appreciable diminution to a depth of 1,000 ft. Definite proof is lacking, but doubtless to many the gambling chance looks good.

How Do You Sample Your Dump?

SORTING AND DISCARDING "WASTE" ROCK so as to improve the tenor of shipping ore unquestionably is a profitable procedure at many mines. It might be introduced to good advantage at others where it is not used. But like everything else it has its limitations and it is an operation that should be closely watched. A year or two ago a well-known manager took charge of a gold mine in a district that was new to him. One of the time-honored practices was to crush, wash, and sort the ore by hand on picking belts. About 25 per cent of the run-of-mine was ordinarily discarded in this manner. The pickers were mostly men who "knew" the ore and were depended upon to keep down the grade of the reject. The motorman who carried the cars to the dump took a couple of chunks at random—theoretically—out of each car that he dumped, and this sample was assayed daily.

When the new manager had become fairly well acquainted with the ore he began to speculate on the waste dump. He decided that a close checking up would be worth while. Accordingly, unknown to the sorters, he had a twenty-four-hour run of the reject diverted to railway cars. The lot was sent to a custom sampler. The returns showed a little more than $8 in gold, as against an average of $12 for the regular shipping ore! The ore was then sent to the reduction works, where the accuracy of the sampling and assaying was verified. The "waste" was sold and treated for the recovery of the contained gold.

Needless to say, the ore-sorting department was given a vigorous shaking up. It was discovered for one thing that much fine material that appeared to be worthless was brushed off the belt into the reject. This was proved to be bad practice, as the fines invariably ran high, no matter how they looked. The washing equipment was improved: first, in order to remove more completely the valuable adhering fines; and, second, to freshen the surface more thoroughly, so that the pickers could distinguish more accurately between good and bad. Instructions were given the pickers to give the benefit of any doubt in their minds to any piece of rock and to remove only such as they felt sure were "waste." The result was a decrease from 25 per cent to 15 in the proportion removed.

Yet even this was not effective. Similar checking up and sampling on subsequent occasions found lot assays of between $2.50 and $4 per ton. This was still too high. In fact the manager demonstrated that the reject should be kept below $2 to make the procedure of sorting profitable. The combined charge for freight and treatment ranged from $3 on ore with a value under $4.50, to $5 25 on ore valued at from $10 to $15. The inclusion of lower-grade material in a lot of ore frequently would operate to lower the charge applicable to it. The cost of picking, including labor, supervision, and maintenance, necessarily would be charged against the tonnage removed, and other factors entered the equation. Another reorganization of the

picking process followed, with the result that the proportion of reject was reduced to about 7 per cent of the ore hoisted, but even now car lots are diverted and sampled periodically to see how the pickers are doing.

At mines where the ore contains various metals, and is sold to a smelter under a more or less complicated schedule, the problem of determining the limiting tenor of the discard might be more difficult; it might fluctuate with variations in the market price of lead or copper. But this does not alter the general principles. Even when there appears to be an easy way to distinguish visually between "ore" and "waste" it will always pay to keep a sharp eye on the dump; and even better than that is the plan of getting a dependable bulk sample now and then to check up on the work of the sorters.

Passing of British America Nickel

IN THE *Mining Journal-Press* of Sept. 23, 1922, speaking of the competition in the nickel industry, we said "either the International company must stick to its old price level and divide the market with its two smaller competitors, or it must cut the price to such an extent that it will not pay one or both of the other producers to operate. . . . A middle policy may be decided on: assuming that the British America company is the highest cost producer of the three, it may be considered wise to establish the price at a figure just below that at which the British America company can operate. This would eliminate that competition, and would still assure a moderate profit, but would allow the Mond company to sell, in this country, its surplus over European demands, which normally would not amount to much."

For some months residents in the Sudbury district of Ontario have been expecting an announcement of the closing of the British America company, and last week came the news that it has gone into voluntary liquidation, following action by the National Trust Co., involving $6,000,000 first-mortgage bonds, the trust company asking sale of the assets to cover principal and interest. Thus ends one of Canada's most prominent war babies, in which even the British Government was heavily interested financially. Probably the property will be bought up for a song by the International Nickel Co., which will hold it in reserve for such time as the demand for nickel exceeds the capacity of its own plants. This will no doubt come fairly soon so far as the refinery is concerned, but the Murray mine and the Nickelton smelter may not see the wheels turn for some time. The British America's equipment is of the best throughout.

Recently, owing to bitter competition, the price of nickel has been only two-thirds to three-quarters of that which existed before the war, though the demand had been better than at that time. Thus is the condition in the copper industry duplicated, only to a greater degree. With the British America competition removed, the price is likely to exhibit a mild advance, as present prices do not mean a very attractive profit for anybody. As to the Mond company, there is little probability that this organization will be forced to discontinue operations; it is too well intrenched abroad and its method of refining and the patents which it controls enable it to produce grades of nickel and copper salts which will have a fairly stable market.

The British America company made a good fight, and in a technical way was able to show its competitors a few things of interest. It suffered from low-grade ore and high-cost steam-generated power, and it felt the lack of the financial resources commanded by its two old-established competitors. It will be some time before another company will dare to enter this field.

Setting a Good Example

KANSAS AND GEORGIA deserve both mention and praise for their attitude toward mining examinations and discreditable stock-selling methods, as reported from those respective commonwealths in the last week. In the first-named state the Supreme Court declared an appointee of the Governor to be ineligible for the post of Chief Mining Inspector, because that executive's choice for the position had been subjected to no examination to establish his ability. The Kansas State Industrial Court named a temporary appointee to act as State Mine Inspector, with the understanding that the man chosen by the Governor should be given the place only if he proved his ability by passing a critical examination. The recent scandals in Washington emphasize, more emphatically than most of us wish, the folly of paying political debts with public office.

In Georgia, two get-rich-quick stock-selling operators have just pleaded guilty of neglecting to observe that state's Securities Commission regulations. Each was fined $500, and the sentences of twelve months with the chain gang were suspended on their promise to be good in the future—in Georgia.

We commend these wholesome examples to the executives of the other states in the Union.

The Need of Production

THAT THE WORLD'S MOST CRYING NEED today is greater production and manufacturing activity among its peoples under conditions which will promote individual prosperity and happiness is the sentiment of a resolution of the National Committee of the World's Power Conference just held in London. This can be largely achieved, it is asserted, by the fuller development of national power resources and by the establishment of the most economical means for the general distribution and utilization of energy.

Lack of production is indeed troubling the world today, those countries directly where conditions of employment are acute and indirectly in those more fortunate, like the United States, which suffers sympathetically owing to the resultant lack of trade. Abroad, millions are hoping for a change that will permit a greater volume of manufactures. To enjoy life they must work. The resolution means much to them.

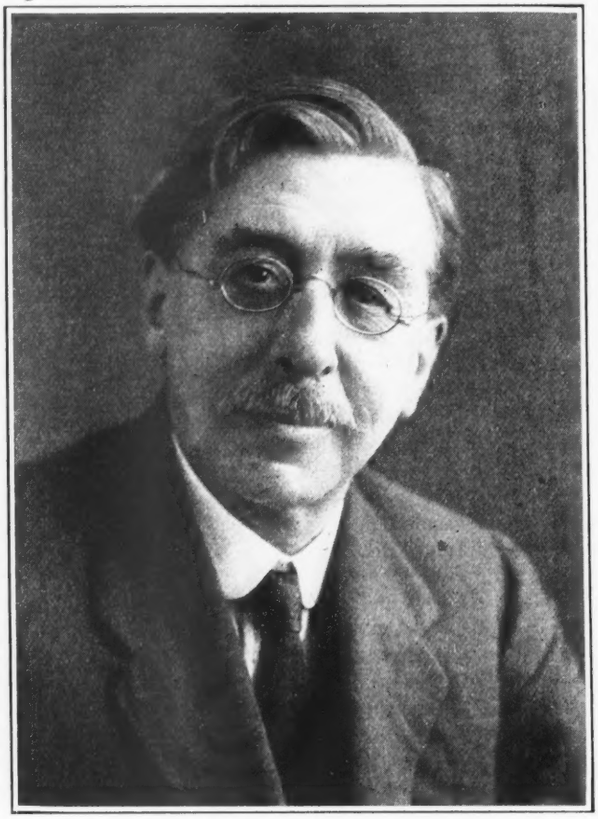
Viewing conditions closely in this country, one sees that where production is a factor in economic woe, there appears to have been too much of it, locally, rather than too little. Witness the situation in the Tri-state zinc district and in the copper industry in general. In these cases it is excess plant capacity, due to expansion under war conditions and resulting in an output still too great for normal peace-time needs. Most certainly the conference resolution is not to be interpreted as meaning that greater production is a crying need in the United States, although there are doubtless those who think so. In a material age like this production is likely to be overworshipped. The conference did well to add that it is under conditions which will promote individual prosperity and happiness that increased production is desirable.

Metallurgists of Note

F. W. Harbord

By W. A. Doman

F. W. HARBORD, the distinguished British metallurgist, received his technical education at the British Royal School of Mines, where he studied metallurgy under the tutelage of the late Professor Roberts-Austen and was Bessemer Medallist of his year. After he left the School of Mines, Mr. Harbord was for a short time associated with Dr. J. E. Stead, of Middlesbrough, and he was subsequently appointed to the position of metallurgical chemist at the works of Sir Alfred Hickman and the Staffordshire Steel & Ingot Iron Co., Ltd., where for seven years he was professionally identified with the development of the basic bessemer and basic open-hearth processes, and where he gained experience in blast-furnace and general steel-works practice. He next became the manager of the steel works of Messrs. George Hatton, Sons & Co., of Bilston, in which position he had charge of an acid bessemer plant for the manufacture of tinplate bars, and where he gained experience in the manufacture of Staffordshire wrought iron. In 1892 he was appointed metallurgical chemist to the government of India at the Royal Indian Engineering College, at Coopers' Hill, where he was responsible for the greater part of the analytical work that was conducted for the Indian Government Railways. In 1904 Mr. Harbord was appointed metallurgist to a commission that was sent over to Europe by the Canadian Government to investigate and report on the status and position of electric smelting in Europe, and as a member of this commission he visited all of the principal electric smelting works on the Continent. In 1909 he was selected by the Transvaal Government to visit that country and report on the possibility of starting an iron and steel industry on the Rand, and in this connection, and during the course of this work, he investigated the iron-ore, fuel, and limestone resources of the country. In 1916 he was awarded the Bessemer Medal by the Council of the Iron and Steel Institute for his technical work in connection with iron and steel. Mr. Harbord is a member of Council of the Iron and Steel Institute, a past president of the Institution of Mining and Metallurgy, has served on the Council of the Institute of Chemistry, of which he is a fellow, and has served also on various government and departmental committees during and since the Great War. For eight years previous to the war, Mr. Harbord was a civil member of the Ordnance Board and he is at the present time a civil member of the New Ordnance Committee. He has made various visits to America and to Canada to report on iron and steel projects, and especially in connection with Dominion Steel, for which company he has acted as consulting metallurgist for some years. During the war he acted as honorary metallurgical adviser to the Ministry of Munitions, and the distinction of the C.B.E. was conferred upon him for his war work. After the closing of the Royal Indian Engineering College, in 1905, Mr. Harbord started in private practice as a consulting metallurgist and chemist at 16 Victoria St., Westminster, and in 1908 he went into partnership with the late Edward Riley, and he is now the senior partner in the firm, having laboratories both at Westminster and Finsbury Square. Apart from his consulting and analytical practice, he frequently acts as arbitrator in disputes concerning metallurgical matters and as expert witness in technical law cases. In addition to Mr. Harbord's authoritative position and standing in all matters relating to the metallurgy of iron and steel, he has had a large experience in general metallurgy, especially in the electric smelting and metallurgy of zinc ores, and has frequently visited Norway and Sweden, Silesia, and other parts of the Continent, and reported on important works in these countries in connection with zinc and other metallurgical industries.



F. W. HARBORD

Mr. Harbord, after visiting the principal electric furnace works in Europe, wrote several papers on this subject. He has also had the opportunity to study his specialty in the United States, in Canada, and as stated, in South Africa. He is the author of the standard book, "Metallurgy of Steel" and of many technical papers that have been presented before various technical and scientific societies.

The Mount Isa Silver-lead Field
Australia's Newest Find

An Account of a Visit to the Cloncurry District, Queensland, with a Description of the Unique Cobalt Mine Near Selwyn

By A. W. Newberry
Mining Engineer, 2 Rector St., New York

A JOURNEY from the more populous parts of Australia to the mining regions of northwestern Queensland is a thing not to be undertaken without due regard to the element of time. I had visited Kalgoorlie and Broken Hill, but these are old, established camps. A new field always makes a strong appeal to me, so I determined to see Mount Isa. I was in Melbourne with a month at my disposal, and a month would be none too long. I should be obliged to spend two weeks of it in travel.

DISCOVERED in March, 1923, the Mount Isa field, in the Cloncurry district of Queensland, has now been proved over a maximum width of 3,000 ft. and a length of 20,000 ft. A small amount of high-grade ore has been shipped, and exploration work to a depth of 80 ft. has indicated the presence of a considerable tonnage of medium-grade ore. It has not yet been demonstrated that the ore continues at depth. Exploration work is still in progress.

Leaving Melbourne at 4 o'clock on a Monday afternoon and changing to a sleeper at Albury, on the border between Victoria and New South Wales—because at that point the railway gage changes from 5 ft. 3 in. to 4 ft. 8½ in.—I arrived at Sydney about 11 Tuesday morning. I left Sydney the same afternoon for the north. At Newcastle, 104 miles north of Sydney, where the Broken Hill Proprietary Mines Co., taking advantage of the high-grade coking coal mined in the vicinity, has erected a modern steel plant, the train stops twenty-five minutes for dinner. Dining cars are not provided in New South Wales. The meals at the stations are quite good, though not up to the "Fred Harvey" standard. They become progressively worse as one travels northward.

The sleeping cars are divided into compartments with two and sometimes four berths in each. The berths are arranged crosswise. No provision is made for heating the trains, but there are always plenty of blankets. Nothing much in the way of service is attempted, the Australian railways being owned and operated by the government. At Wallan-garra, where we arrived early Wednesday morning, there is another change of gage—this time a reduction to 3 ft. 6 in., which is the standard not only for Queensland but also for a part of South Australia and all of West Australia. The existence of three different gages constitutes the most pressing problem in the internal commerce of Australia. Passengers can of course move with ease from one train to another waiting on the opposite side of the platform, but the transfer of freight with every change of gage is a serious matter.

One traverses very pretty country between Wallangarra and Brisbane. The greater part of it is well forested and hilly, with an altitude of 2,000 to 3,000 ft. Just north of Toowoomba, where the descent to the coastal plain begins, there are some fine views. An observation car with broad rear platform adds to the enjoyment of this part of the journey. A little after 4 in the afternoon, the train emerges from hills and forest and for the next two hours crosses a well-cultivated farming region.

I arrived at Brisbane about 7 o'clock Wednesday evening, and spent the whole of Thursday there, as I wished to get all the information possible on the mining districts in the north. The Department of Geology publishes an excellent geological map of Queensland, and the bulletins dealing with the copper and cobalt resources were not out of print. I was also able to obtain back numbers of the *Queensland Government Mining Journal* without going to a speculator in technical publications. Brisbane is a wide-awake city of about 200,000 people. I would gladly have spent more time there.

On Friday morning I resumed my journey. Within less than an hour the train entered a forest more tropical in appearance than anything I had yet seen in Australia. There are a few small clearings, where attempts are made to grow pineapples and other fruit, and others where grain is grown with apparent success. Several granite pinnacles, two of them more than 1,000 ft. high, rise abruptly out of the forest. At no time in the next 800 miles were we more than 20 miles back from the coast.

Old Gold Camp Now a Farming Center

Gympie, once famous as a gold camp, is the first meal station north of Brisbane. Nearly all the mines have ceased production, but as the soil is good and much of the land had been cut over for timber and fuel, Gympie has become an important agricultural center.

A run of forty hours from Brisbane brought me to Townsville at 2 o'clock on Sunday morning. As little running as possible is done on Sunday, because train crews obtain double pay on that day. One must be philosophical and wait until Monday. Fortunately, there is a good hotel at Townsville, with a well-kept park between it and the sea, and an excellent band played in the park that evening. There were no "Keep Off the Grass" signs.

On Monday about 10 in the morning I was on my way again, bound for Cloncurry. Lunch at Ravenswood Junction was so bad that I could eat nothing but the bread. At about 3 in the afternoon the train stopped at Charters Towers. The first "s" looks superfluous, but that is how it is spelled. Like Gympie, this town of about 20,000 inhabitants has prospered since the exhaustion of the gold mines. It proved a convenient supply point for the sheep country back of it, and so experienced no appreciable setback.

I bought some fruit at Charters Towers and deter-

mined to live on that until we reached Cloncurry, but early in the evening, after crossing the continental divide (1,800 ft. above sea level), a dining car was attached and the dinner proved fairly good. Two sleepers were picked up later, and I managed to get a "lower" in one of them. On arising the next morning, I found the country completely changed. The trees were gone, and nearly level grassy plain stretched away to the horizon in every direction. This part of Queensland is known as the rolling downs, and the sedimentary rocks of that region have been classed as the Rolling Downs formation and assigned to the early Cretaceous. About noon the train entered a range of low hills with a sparse growth of small gum trees. The rocks of this region have been provisionally ascribed to the Silurian. They are for the most part metamorphic and consist of slate, schist, quartzite, and a little crystalline limestone. This is the formation throughout the Cloncurry copper district, extending with minor interruptions from Mount Oxide on the northwest to Mount Elliott on the southeast, a distance of 160 miles. It is known as the Cloncurry formation.

We reached Cloncurry about 1 o'clock, and after a square meal at the Post Office Hotel, I boarded the biweekly mixed train for Selwyn. The distance is 71 miles, and the running time is five hours. This branch railway was built to serve the Mount Elliott mine at Selwyn and the Hampden mines at Friezland, 50 miles south of Cloncurry. These copper mines, together with the Great Australia at Cloncurry and the Duchess, 70 miles southwest of that place, have all produced large quantities of direct-smelting ore, most of which was put through the Mount Elliott smelter. They have all been closed since 1920, on account of the low price of copper and unsatisfactory labor conditions.

At Selwyn, where I arrived at 8 in the evening,

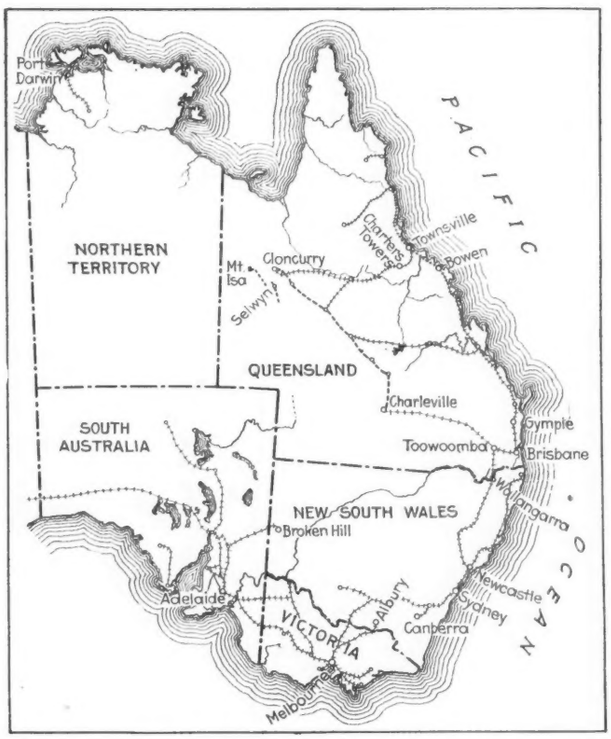
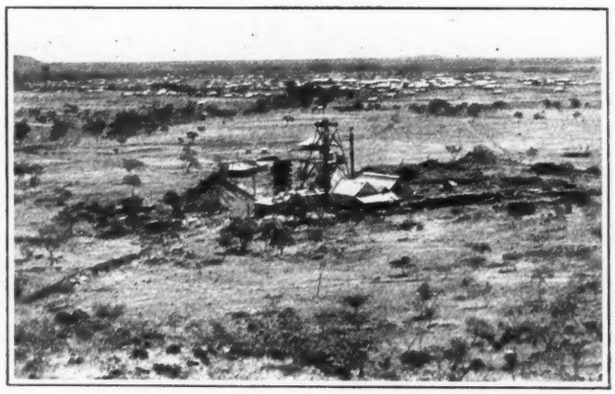


Fig. 1—Outline map of eastern and central Australia, showing location of Cloncurry district, Queensland, and other places visited.



Great Australia mine. Town of Cloncurry in background.

just eight days and four hours from the time I had left Melbourne, I was met by L. E. Nicolson, manager of the Mount Elliott group and the Mount Cobalt mine. With him the next day I visited Mount Cobalt, 17 miles south of Selwyn. As far as I know, this is the only cobalt mine in the world. The ore occurrence is fully described by J. H. Reid in the *Queensland Government Mining Journal* for Jan. 15, 1921, under the heading, "Cobalt in the Cloncurry District."

About four years ago Mark J. Eves, a prospector, brought Nicolson a specimen of erythrite, and wanted to know if cobalt ores could be profitably worked in that region. Nicolson sent him back to open up the lode and later secured an option on it, which, after some further exploratory work, he and his associates exercised.

The lode outcrops on the side of a low ridge near, and in some places along, the contact between a fine-grained dolerite and the schist of the Cloncurry series. The dolerite is intrusive into the schist. The lode is tabular, with a maximum width of about 10 ft. It strikes N. 5 deg. W. and dips 72 to 80 deg. east. It has been opened for a distance of 400 ft. on the surface and for a shorter distance on the 112-ft. level. The average stoping width is about 4 ft. At the time of my visit (May, 1924), a station had been cut at the 224-ft. level of the main incline shaft and a crosscut was being driven toward the lode. Only about half of the 400 ft. over which mineralization occurs is workable ore. Oxidation extends to a depth of about 50 ft. The ore-mineral of the oxidized zone is erythrite, or cobalt bloom, $Co_3As_2O_8.8H_2O$, and that of the sulphide zone is cobaltite, CoAsS. In parts of the oxidized zone the pink cobalt bloom is masked by soft, brown oxides of iron and manganese. Reid has called this material "cobaltiferous wad." Some of it contains enough cobalt to be classed as ore except for the fact that the metal is not readily recoverable by the milling process now in use. A thin seam of scheelite was found at one place on the footwall of the lode. Hornfels characterizes that part of the schist which is in direct contact with the intrusive.

Typical contact-metamorphic minerals are not in evidence. The fissure or shear-plane which gave access to the mineralizing solutions is found both in the dolerite and in the schist. At one place in the 112-ft. level the lode is in the dolerite more than 40 ft. from the contact. While the intrusion undoubtedly caused a plane of weakness and possibly some actual fracturing, there is nothing about the lode which suggests contact origin.

At the time of my visit the mine was working two shifts and producing about sixty tons of 3 per cent

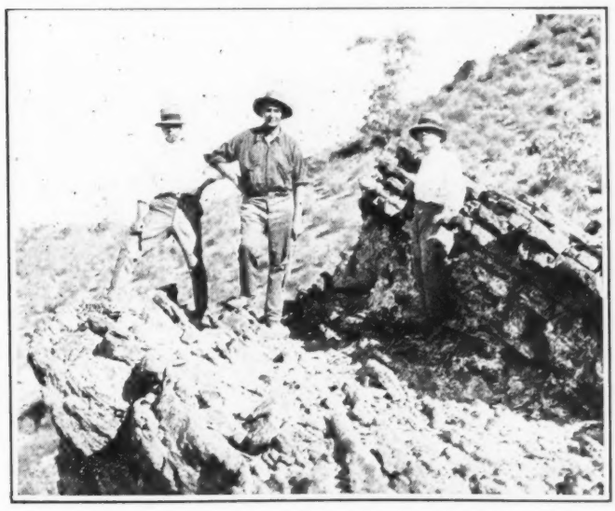
cobalt ore per day. A mill of 100 tons' daily capacity is situated close to the main shaft. The ore, after crushing, is ground in ball mills and concentrated on Wilfley tables and Senn vanners. The concentrate, containing about 25 per cent cobalt, is sacked and hauled by motor truck to Selwyn, from which point it is shipped to Europe. Power is generated in steam boilers fired with wood. Air is compressed at the power house, and about 200 kw. is transmitted as current to the mill and hoist.

The principal difficulty has been in securing an adequate water supply. Water is pumped a distance of four miles, and that which runs off with the tailing is impounded and returned to the circuit. It is only during the rainy season, from December to March, that the mill can be operated at full capacity. Several months were lost both in 1922 and 1923 owing to the complete failure of the water supply.

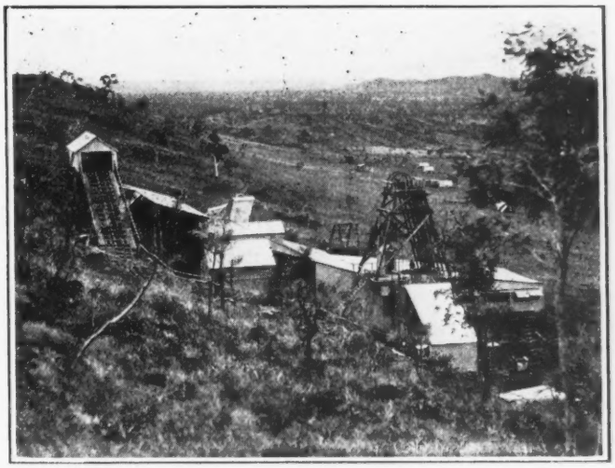
From Selwyn to Mount Isa

After a day each at Mount Cobalt and Mount Elliott, Nicolson and I took the train to Malbon, where we were met by Douglas MacGillivary and his brother Claude, with a Nash touring car. The only road from Cloncurry to the Mount Isa silver-lead field parallels the railway as far as Duchess; then it runs northwest a distance of 64 miles to the new camp. The distance from Cloncurry to Mount Isa by this road is 135 miles. There are only two trains per week each way between Cloncurry and Duchess, so the trip is usually made by motor. Douglas MacGillivary is the man who obtained options covering nearly half the new field for the Mount Isa Mines Co. A significant feature of these options is that nearly all the locators took stock in the company for their holdings.

We stopped at Duchess for lunch and reached "the diggings" about 5 in the afternoon. The country through which we passed is fairly well forested, gidyea and eucalyptus predominating. The gidyea has a yellow blossom and a particularly offensive smell, which is most noticeable after a rain. About half way from Duchess to Mount Isa the road crosses the watershed between Wills Creek, which flows toward Lake Eyre—a dry lake comparable to the Carson Sink in Nevada—and the West Leichhardt River, whose waters, when there are any, eventually reach the Gulf of Carpentaria. The watershed is imperceptible, the entire 64 miles being



Mount Isa outcrop where discovery was made. Left to right, D. MacGillivary, E. C. Saint Smith, L. E. Nicolson



Mount Cobalt mine and mill

almost dead level except for the gullies of dry stream beds. A range of rugged hills with their tops 500 ft. to 800 ft. above the plain makes its appearance to the east of the road about 20 miles south of Mount Isa and continues north along the east bank of the Leichhardt River for some distance beyond the diggings. These hills are a serious obstacle to the building of a direct road or railway from Cloncurry to the new field—air-line distance 66 miles—or from Wee MacGregor, an air-line distance of 32 miles.

The present townsite, with its melee of tents, corrugated-iron lean-tos, its huts with walls of gunny sacking, and roofs of leaky boughs or tarred paper, and its "open-to-the-sky" cinema, is situated on the west bank of the river about 500 yd. from the mineral belt. The only building fit to be called a house is the combined office and manager's residence of the Mount Isa Mines Co. This is a little less than a mile north of the temporary townsite and forms the nucleus of a second settlement consisting of sleeping tents, storage sheds, a blacksmith shop, and the headquarters of the Mount Isa Proprietary Mines Co. A third organization, the Mount Isa South Mines, maintains a headquarters at the main townsite. The population of the camp in May, 1924, was a little under 400.

Leases Laid Out Regularly, With No Fractions

I was made welcome by E. Deighton, authorized government surveyor for the northern district of Queensland, who was engaged upon a survey of the Mount Isa company's holdings. It is due to him that all the leases in the field are laid out on true north-south lines and that there are no angular fractions. Nicolson and I spread out our blankets in Deighton's "front yard," and the others found shelter with some hospitable lease holders. One of the charms of Australia is the delightfully informal hospitality of her people, and this characteristic is emphasized in such surroundings as those in which we found ourselves.

We spent the whole of the next day with E. C. Saint Smith, general manager of the Mount Isa company's mines. He took us over all of the company's holdings, from the Crystal on the south to the Leichhardt King on the north. Mr. Saint Smith, until a few months ago, when he obtained a year's leave of absence, was Queensland government geologist. In this capacity he visited Mount Isa in September, 1923, and again in December of that year. His first report was published in the

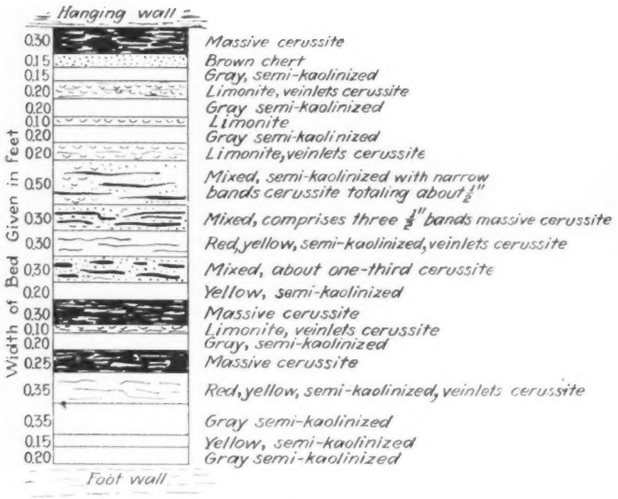

Hanging wall
Width of Bed Given in Feet
0.30 Massive cerussite
0.15 Brown chert
0.15 Gray, semi-kaolinized
0.20 Limonite, veinlets cerussite
0.20 Gray semi-kaolinized
0.10 Limonite
0.20 Gray semi-kaolinized
0.20 Limonite, veinlets cerussite
0.50 Mixed, semi-kaolinized with narrow bands cerussite totaling about ½"
0.30 Mixed, comprises three ½" bands massive cerussite
0.30 Red, yellow, semi-kaolinized, veinlets cerussite
0.30 Mixed, about one-third cerussite
0.20 Yellow, semi-kaolinized
0.30 Massive cerussite
0.10 Limonite, veinlets cerussite
0.20 Gray, semi-kaolinized
0.25 Massive cerussite
0.35 Red, yellow, semi-kaolinized, veinlets cerussite
0.35 Gray semi-kaolinized
0.15 Yellow, semi-kaolinized
0.20 Gray semi-kaolinized
Foot wall

Fig. 2—Cross section of Rio Grande incline, 15 ft. below collar, Mount Isa field. This section is taken at right angles to the footwall. (See p. 170.)

Queensland Government Mining Journal for Nov. 15, 1923, and the second in the same publication for Jan. 15, 1924. In these two reports he describes the ore occurrence at each of the workings in turn, giving a large number of assay results. His conclusions point to a bright future for the camp, and all the work that has been done since the reports were published tends to corroborate those conclusions. The deepest working referred to in the reports is the Silver Lena incline shaft, 26 ft. This was subsequently sunk on ore to a depth of 53 ft. and there are two vertical shafts which had reached a depth of 80 ft. at the time of my visit.

That part of the district in which the Mount Isa company has no interest I visited later with Deighton—Nicolson and the MacGillivarys having been obliged to return to Cloncurry. The weather during my stay of six days could not have been better. It must be remembered that Mount Isa is within the tropics (latitude 20 deg. 45 min. S., longitude 139 deg. 29 min. E.) and, being at a low altitude—1,200 to 1,500 ft.—it is often very hot. The principal discomfort was a swarm of small bluebottle flies which followed me everywhere I went. Mr. Saint Smith tells me that in the rainy season it is necessary to wear a head net and gauntlets as protection against them. Although there were stagnant pools in the sandy bed of the West Leichhardt, I saw no mosquitoes.

Mount Isa Less Than 100 Ft. Above the Plain

The first discovery was made by J. C. Miles in March, 1923, on the site of what is now the Mount Isa lease. The area covered by surveyed leases in May, 1924, was about 3,000 by 20,000 ft., or roughly two square miles. The accompanying sketch-map shows the ground held by, or under option to, the three principal companies. The contours are roughly sketched from aneroid readings. The mineral zone follows a range of low hills bearing north and south and attaining a maximum height of 250 ft. above the plain which surrounds it on all sides. The outcrop of the Mount Isa lease is less than 100 ft. above this plain. It appears to be the custom in Queensland to prefix the word "mount" to names of mines and mining districts, regardless of the topography. The hills have a steep eastern slope with low fault-scarps in some places, and a more gradual western slope. A marked feature of the topography is the presence of ribs of brown-stained chert standing several feet high and extending for several hundred yards in a north-south direction. The rugged hills east of the river have already been mentioned. There is also a range paralleling the mineral zone on the west at a distance of 2,000 ft. to one mile. This latter range rises to a maximum height of about 600 ft. above the plain.

The surface in the Mount Isa district is covered with porcupine grass and spinifex, which makes the wearing of knee boots or leather leggings highly desirable. There is a moderate growth of trees, among which Mr. Saint Smith has identified the gidyea, coolabah, carbean, desert box, beefwood, bloodwood, lancewood, snapping gum, and river gum. The annual rainfall is given by Mr. Saint Smith at 16 to 25 in., most of which occurs in the months of December, January, February, and March.

Ore Occurs in Cloncurry Series

The strata in which the lodes occur consists of thinly bedded shale, slate, sandstone, and chert belonging to the Cloncurry series. The evidence for assigning this series to the Sifurian lies in the finding of certain fossils 12 miles east of Cloncurry. The relation of the Cloncurry series to rocks outcropping along the eastern edge of the Northern Territory indicates for it a Cambrian or possibly pre-Cambrian age. The beds strike north-south and, except in localities of intense folding, dip 40 to 75 deg. west. A decided contortion occurs on and in the immediate neighborhood of the Racecourse lease, where both anticlinal and synclinal folds were observed, plunging northward at a low angle. The nearest outcrop of igneous rock is a boss of granite 7 miles to the southwest.

The cherty ribs above referred to serve as valuable guides to the discovery of ore. Many of the lodes are in close proximity to these cherty ribs, usually on the footwall side of the latter. The highly indurated character of the chert outcrops has been found not to persist more than a few feet below the surface.

The ore occurs as (1) bands of massive cerussite, usually dark in color; (2) veinlets of cerussite, accompanied by soft, brown limonite; (3) veinlets of cerussite

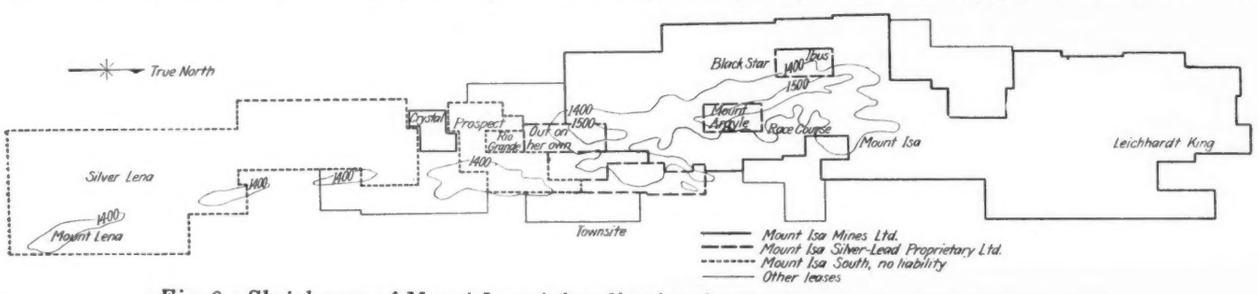


Fig. 3—Sketch map of Mount Isa mining district showing leases surveyed to May, 1924

in bluish gray (occasionally light yellow) kaolinized country, and (4) small tabular masses of finely crystalline galena. The last named is the principal ore mineral at the Racecourse, where it is especially in evidence near the apices of folds. In no case was a band of ore observed to cross the bedding planes.

I quote the following on the subject of ore occurrence and genesis from Mr. Saint Smith's first report:

"Extreme compression . . . has severely buckled the strata and thus opened the laminæ and bedding planes, into which silver-lead has been introduced by heated solutions accompanying igneous intrusion and rising along the lines of least resistance. . . . In odd instances the ore has not merely filled the fissures produced by the opening of the laminæ, but has also more or less replaced the bounding strata—especially where the latter is inclined to be friable sandy clay-shales; speaking generally, however, the individual seams of ore are remarkably regular in width over very considerable lengths already proved. I saw no evidence at all to suggest that these seams of ore might have been produced from the wall rocks by the process known as lateral secretion. . . .

"A little copper staining is to be seen along the prominent belts of quartzite near the main ore channels, especially lining the wind-produced cavities in these outcrops. . . . When a little copper is observed in the actual orebodies, the silver values are mostly much higher than elsewhere, suggesting possibly that tetrahedrite accompanies the lead at times. . . .

"The major portion of the lode outcrops is very dark, due to a thin surface incrustation of manganese and a little iron oxide. This fact, when it became apparent, enabled the original prospector to detect practically all the lode outcrops within a day or so; in fact, he noticed the peculiar dark-brown bands on top of a hill on what is now the 'Out-on-Her-Own' property from a distance of half a mile."

It must be remembered that the known mineralized area has been considerably extended since the above was written. It would be impossible at present for anyone to see all the lode outcrops in the field in so short a time unless he knew the exact location of each. The lodes in the north-central part of the field, where the first leases were taken up, may be grouped for convenience into five parallel north-south ore channels, at least one of which has been shown to consist of several lodes.

The following is the average analysis of shipments from the Mount Isa field up to Sept. 18, 1923:

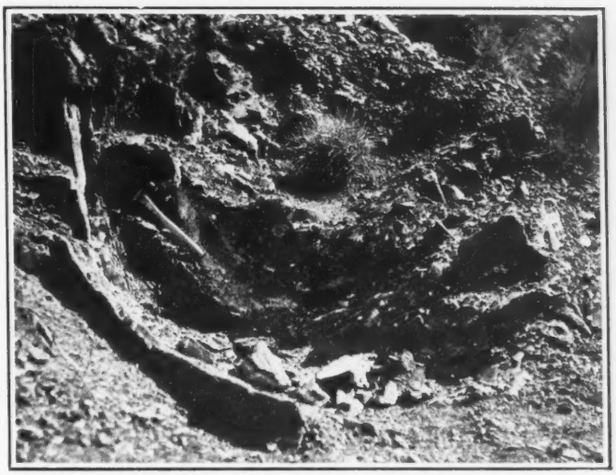
Lead, per cent	64.0
Alumina, per cent	5.4
Ferrous oxide, per cent	3.75
Silica, per cent	4.9
Sulphur, per cent	1.85
Silver, oz. per ton	55

All ore shipped contained traces of gold. Zinc and arsenic have been found as traces in a few samples only.

Workings Include Twenty-five Shallow Shafts

At the time of my visit there were sixteen vertical shafts 12 ft. to 80 ft. deep, totaling about 520 ft.; nine incline shafts 15 ft. to 53 ft. deep, totaling about 250 ft., one adit in 22 ft., and a large number of cross trenches and open cuts. A crosscut was being driven from the bottom of the Mount Isa shaft at a depth of 80 ft. and had progressed about 20 ft. in the direction of the lode.

The first step in the plan of development followed by the Mount Isa Mines Co. is to sink an incline shaft on the ore and a vertical shaft in the hanging wall at each of its principal showings. The vertical shaft is so placed that it will intersect the lode at a depth of 80 ft., at which level lateral development is to be undertaken and a connection made between the two shafts for ventilation. This plan is modified on certain leases to suit local conditions. All hoisting was being done by windlass, and rawhide "buckets" were used at most of the vertical shafts. No machinery is to be ordered until all the principal ore occurrences have been explored at a depth of 80 ft.

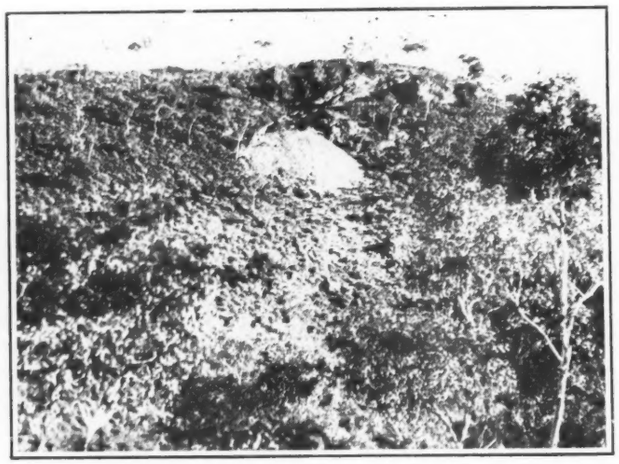


Synclinal fold on Racecourse lease

I shall describe only five of the more important workings:

1. Mount Isa—This lode is the second of the five main ore channels, numbering from east to west. It outcrops for a distance of about 150 ft. along the footwall side of a resistant rib of cherty material dipping 45 deg. west. The lode outcrop for a width of 1 to 2 ft. is black in color owing to a superficial deposit of iron and manganese oxides. An incline shaft—vertical for the first 20 ft.—has been sunk 50 ft. on the lode. The lode matter consists of laminæ of yellow, pink, and red ocherous material containing much sandy lead carbonate, very finely divided. The lode at the bottom of the incline had widened to the full width of the working—about 5 ft. The 80-ft. vertical shaft had passed through

Open cut on Racecourse lease. Massive galena at apex of fold behind pick



The Out-on-Her-Own lease

the lode and the crosscut at the bottom of the shaft was in white and pale yellow kaolinized material.

2. Black Star—This lode, or succession of lodes, is the most westerly ore occurrence so far discovered. A prominent outcrop of silicified shale totally devoid of vegetation occurs on this lease as a western outlier to the range of hills which forms the bulk of the mineral zone. The dip of the shales is 60 to 70 deg. west. In crossing this outcrop from west to east I encountered twenty-one seams of black oxide of iron and manganese in a distance of 85 ft. These seams are from 1 to 8 in. in width, and in nine of them I was able to distinguish the carbonate of lead. Thirty yards north of the above-mentioned outcrop and extending eastward from it is a cross trench 200 ft. long which cuts many similar seams. At 70 ft. from its western end and extending for 5 ft. along the trench, the seams appear to be spaced close enough to constitute a workable lode. A similar condition exists at a point 60 ft. farther east, and near the eastern end of the trench there is so much cerussite for a distance of 30 ft. that it would not surprise me in the least to learn that further exploration had proved a lode of this width. There are two vertical shafts, each about 30 ft. deep. One is some distance west of any proved ore, and the other is being sunk opposite a point in the cross trench which shows very little lead.

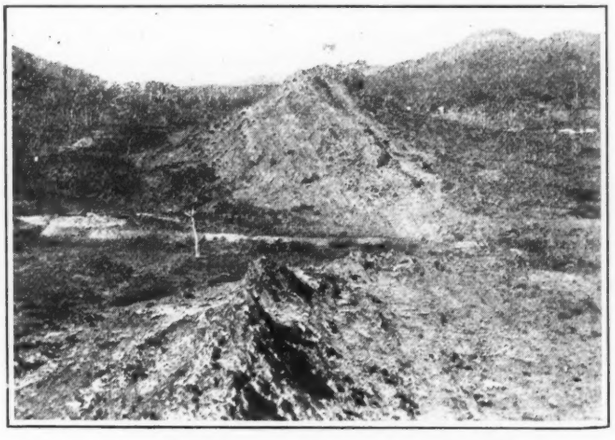
3. Out-on-Her-Own—The lode channel which has been opened on this lease is probably a southward continuation of that on which the Racecourse workings are situated. This would make it the middle one, or the third, numbering from the east. Near the north and south ends are trenches along the lode which expose bands of fairly clean carbonate ore. A little north of the middle of the lease, on a steep slope near the top of the hill, an adit had been driven 22 ft. northward. The face of this working carried 6.5 ft. of lode matter without exposing the hanging wall. The strike is a few degrees east of north and the dip is 57 deg. west. There are several narrow bands of cerussite interbedded with buff-colored, semi-kaolinized shale. Galena is present, but is subordinate to cerussite. From one-quarter to one-third of the face is clean ore. The shale is laminated and minutely folded. Mr. Saint Smith gives the assay result on a sample taken by him across the outcrop into which this adit was later driven. He obtained 44 per cent lead and 39.8 oz. of silver over a width of 8.7 ft. On the hanging-wall side of the outcrop is a mass of chert highly impregnated with iron and manganese and containing cavities which appear to have been caused by solution.

4. Rio Grande—Just south of the Out-on-Her-Own lease is a sharp break in the ridge, which appears to have been caused by an east-west fault. Mr. Saint Smith believes that the country south of this break has been displaced toward the east and that the ore which has been exposed on the Rio Grande and Prospect leases, although it lines up quite nicely with the Out-on-Her-Own lode, is really a continuation of one of the western ore channels. It has some features in common with the Black Star lodes.

Close to the eastern boundary of the Rio Grande an incline shaft has been sunk 18 ft. on a well-mineralized lode striking north-south and dipping 50 deg. west. One hundred and five feet west of this incline, and at a lower elevation, is a north-south trench which shows bands of lead-carbonate ore dipping 61 deg. west. Between these two workings there are minor ore occurrences. A vertical shaft 67 ft. west of the incline, and 38 ft. east of the north-south trench, had been sunk 63 ft. and had cut several seams of ore, but lacked about 10 ft. of encountering the east lode. From the footwall of the east lode to the hanging wall of the west lode the perpendicular distance scales 68 ft. From one-quarter to one-half of this width should prove to be workable ore. The sketch in Fig. 2 shows in detail the composition of the east lode as exposed at the south end of the incline shaft 15 ft. below the collar, over a width of 5 ft.

The bands of massive cerussite (78 per cent lead) add up to 1.1 ft. Assuming a specific gravity of 6 for this material and 2.5 for the remainder of the lode, the lead content of this 5-ft. section figures out at 34.6 per cent. After making my sketch I cut a groove sample across the full width. This sample was later assayed at the government assay offices in Cloncurry and gave 42.4 per cent lead and 20.3 oz. of silver. The discrepancy may be accounted for by the presence of lead minerals disseminated through the country rock and in veinlets too narrow to measure.

5. Prospect—This lease adjoins the Rio Grande on the south and is crossed by the same lode channel. A 32-ft. incline shaft near the north boundary shows one 5-in. band of massive cerussite and three smaller bands of the same mineral. A vertical shaft, started on the hanging-wall side of the lode, had reached a depth of 80 ft. at the time of my visit. The first band of massive cerussite was cut at a depth of 65 ft. Five 2-in. bands of massive cerussite and three narrower bands were



Black Star outcrop from the north

exposed in this shaft. Oxides of iron and manganese were coming in at the bottom, but there was nothing to indicate that the footwall had been reached. The Mount Isa South Mines Co., which is developing this lease, plans to sink to a depth of 100 ft. and then drift south on the lode.

Little Ore Shipped to Date

Up to Jan. 1, 1924, 154 tons of sorted ore from the Mount Isa field had been sold in Cloncurry. Little ore is being shipped at present, the operators being principally concerned with exploration and development.

The most serious problem in the district is the supply of water. At the time of my visit, about six weeks after the end of the rainy season, the West Leichhardt was dry except for a few pools. The government has sunk wells along the road between Mount Isa and Duchess, but no water had been made available close to the mines. None of the workings has reached water level, nor are they likely to for some time. The immediate needs of the camp can doubtless be met by wells along the course of the river. When large-scale production begins, it will probably be necessary to impound the run-off of some of the tributary streams.

Continuance of Ore at Depth Still To Be Proved

If there was ever any doubt about Mount Isa making good, this doubt has been removed by the work that has been done in the last six months. The ore should be a simple one to treat, and the silver ratio is higher than that of the Coeur d'Alene or Broken Hill. Furthermore, the demand for lead is likely to exceed the supply for a long time, perhaps throughout the life of the mines. The only question now is to what depth economic mineralization will extend. It has already been proved over a large area, and I look for this area to be extended both east and west beneath the alluvium of the plain. If the metallic content of the lodes persists without appreciable diminution to a depth of 1,000 ft., which seems to me well within the realm of probability, then Mount Isa will take its place along with Broken Hill and the Coeur d'Alene as one of the great silver-lead deposits of the world.

Preliminary surveys have been made for a railway to serve the new district. It is possible that a direct route from Cloncurry to Mount Isa by way of the West Leichhardt telegraph station will be chosen, but the probability is that a branch line will be built from Duchess. Although the haul to the coast would be longer by this route, the expense of construction would be considerably less, and the line might later serve as part of a system connecting the southeast coast of Australia with Port Darwin, on the north coast, or some port on the Gulf of Carpentaria. It is generally believed that railway construction will be started as soon as development at Mount Isa has progressed a little further.

Mount Isa ore and concentrate will probably be smelted in the neighborhood of Bowen, on the east coast of Queensland, where there are extensive deposits of coking coal. This will necessitate a rail haul of about 750 miles, but it will be a great boon to the government railways, which, for the last few years, have been operated at a loss.

My return journey to Sydney was quicker, more interesting, and pleasanter in every way than my journey northward. I traveled to Cloncurry by automobile, and the trip from there to Charleville I made in one of the De Haviland planes of the Queensland and Northern Territory Aerial Service. The distance is 580 miles, and the flying time is between six and seven hours. I heartily recommend this method of travel in visiting distant mining regions. From Charleville, which is 460 miles west of Brisbane, the journey to Sydney is made by rail and requires a little less than two days.

In closing I desire to express my sincere thanks to L. E. Nicolson, of Mount Elliott; E. C. Saint Smith, of the Mount Isa Mines Co.; E. Deighton, of Charters Towers, and Douglas and Claude MacGillivary, of Cloncurry, for their warm-hearted hospitality and their willingness to show me all there was to be seen.

Barytes Production Increased in 1923

There was a notable increase in the output of barytes in the United States in 1923, according to the U. S. Geological Survey, working in co-operation with the geological surveys of the producing states, and of lithopone and the various barium chemicals, and there was a resultant decrease in the imports of these commodities. On the other hand, the production of ground barytes fell off considerably and the imports were larger.

The crude barytes shipped from mines in the United States in 1923 amounted to 214,183 short tons, valued at $1,664,156, an increase of 38 per cent in quantity and 48 per cent in value over the output in 1922. This output was exceeded only in 1916 and 1920. Georgia shipped 39 per cent, Missouri 38 per cent, and Tennessee 16 per cent of the total.

Imports of crude barytes in 1923 amounted to 15,045 short tons, worth $93,721 at port of shipment, a decrease of 35 per cent in quantity. A small quantity of barytes was exported to Canada.

The manufacturers of barium products used 210,587 short tons of domestic and imported crude barytes in 1923 in the production of ground barytes, lithopone, and barium chemicals. The shipments of ground barytes were 39,605 short tons, valued at $895,095, a decrease of 14 per cent in quantity from 1922. The sales of lithopone were 98,199 short tons, worth $11,608,443, an increase of 18 per cent in quantity. Manufacturers of barium chemicals report the shipment of 16,803 short tons, worth $1,215,596, a quantity 21 per cent larger than in 1922. These chemicals consisted of 6,362 tons of barium carbonate, 3,301 tons of barium chloride, 6,761 tons of barium sulphate, and smaller quantities of barium hydroxide and sulphide.

The imports of ground barytes were 6,022 short tons, valued at $88,741, an increase in quantity of 28 per cent. There was a slight increase in the imports of natural barium carbonate (ground witherite), which were 1,557 tons, valued at $41,823. The imports of lithopone were 10,440 tons, worth $776,383, a decrease in quantity and particularly in value. There was a decrease of 55 per cent in the total imports of the barium chemicals, binoxide, sulphate, chloride, and artificial barium carbonate. The figures showing the imports of barium hydroxide and nitrate are not available for comparison for dates prior to Sept. 22, 1922, but 181 tons of barium hydroxide, valued at $16,872, and 511 tons of barium nitrate, worth $59,766, were imported in 1923.

Exports of lithopone in 1923 amounted to 1,485 short tons, valued at $176,624, about 8 per cent less in quantity than in 1922.

Origin of Wilshire Gold Ore

Interesting Comparisons With Similar Deposits in Other Localities

By Henry W. Turner
Mining Geologist, San Francisco, Calif.

Henry W. Turner

IN AN ARTICLE in *Mining Journal-Press* of Nov. 18, 1922, an unusual type of ore deposit was briefly described by me. The Wilshire deposit is a mineralized layer of quartzite, averaging perhaps ten feet in width, lying in a quartzite reef which is inclosed in granite. The width of the reef is about 600 ft., more or less, and this reef contains a little gold, averaging perhaps 50c. per ton nearly everywhere, while the commercial ore (mill heads $8 per ton or better) is confined to a narrow streak which is not separated from the country quartzite by any walls or gouge seams. The deposit was designated a bed-vein, as the quartzite of which it is composed conforms in strike and dip with the quartzite walls.

This vein was compared with that of the Snowstorm mine, in Idaho, except as to metallic contents. My information is that the Snowstorm deposit became too low grade in depth to be of commercial value, and this can be easily understood, as the commercial ore that was mined was oxidized ore with secondary enrichment, while the sulphide ore below presumably represents the primary ore too low in copper to be valuable.

With the Wilshire deposit, on the other hand, there is practically no oxidized ore, and, as shown by the drill holes, the ore in depth is as good as or better than that near the surface.

The walls of the Snowstorm, like those of the Wilshire, are of the same sedimentary nature as the vein rock, and hence it is difficult to understand why in both cases the ore is localized in a particular layer rather than being diffused throughout the rock mass. To get some data on this point, Ransome and Calkins, who describe the Snowstorm deposit[1] had thin sections made of the vein rock and found *"that the quartzite has been crushed and that it is traversed by a network of microscopic fractures."* Such fractures would, of course, afford avenues for the circulation of mineral-bearing waters; but the conclusion would have no weight unless it was determined that the wall rocks themselves were not similarly crushed and fractured. Though the larger part of the Wilshire vein is mineralized quartzite; some of it contains contact-metamorphic minerals such as wollastonite, epidote, garnet, and pyroxene. Moreover, the footwall of that part of the vein between the shaft and the big fault that lies northwest of the shaft is formed of a granular and rather friable dark-green rock, which is composed of augite and labradorite as determined by C. F. Tolman from a microscopic examination. This rock seems to have a diabasic texture, but it does not present the appearance of a dike rock in the mine, and I am inclined to regard this green rock as of metamorphic origin and representing an original calcareous layer in the quartzite. A fresh diabase of such a friable nature would be an anomaly.

While these metamorphic minerals noted above are not at the contact of the sedimentary reef with the inclosing granitic rocks, there can be no doubt that they were formed by the metamorphic action of the granite on calcareous materials in the quartzite. Hence, in a large way the precious metals, sulphides, and contact minerals of the Wilshire reef may be considered the final product of contact-metamorphism.

Charles A. Chase has called my attention to his description of gold associated with contact-metamorphic minerals in the Aztec and Ajax mines in Colfax County, New Mexico.[2] The Aztec mine has produced gold to the value of more than a million dollars. Mr. Chase states that the gold occurs in two sorts of deposits: quartz veins and contact-metamorphic deposits, the quartz veins being credited with the greater production. The orebodies were formed along the contact of sandstone with underlying Montana shale, both formations being of Cretaceous age. Hershey had previously designated the so-called shale ore as of contact-metamorphic origin, although not in direct contact with intrusive igneous rock, and Chase states that "The dioritic sill (in the Aztec mine) that underlies the principal productive orebodies on the No. 4 level, and which is separated from them by 40 to 100 ft. of much less altered and absolutely barren shale, might have produced the metamorphism; assuming that the ore represents a layer of shale that was slightly calcareous and thus amenable to an alteration different from that of the non-calcareous shale."

Moreover, Chase shows two areas of monzonite-porphyry adjacent to the Aztec mine on his geological map and considers that the magma of this rock contributed to the formation of the gold and contact minerals found in the so-called shale ore. Thus, the geological conditions at the Aztec mine are somewhat similar to those at the Wilshire mine.

On Lindgren's geological map[3] is shown an isolated area of contact-metamorphic schist of supposed Jura-Trias age, inclosed in granodiorite, lying about one mile southwest of McKinney, on Lake Tahoe. At the east of this schist area is a pond or reservoir known as Quail Lake. To the east of the lake there is morainal material, but the schist to the west of the lake is well exposed and is mineralized with pyrite. At one point a little mining work has been done, and the massive pyrite at this point showed on assay a content of $5 per ton in gold. For a width of 300 ft. or more measured from the lake westerly, the black schist is sprinkled with finely divided pyrite grains not showing idiomorphic forms. There was here, therefore, a possibility of developing a large low-grade gold mine, and for that reason several samples of the mineralized schist were taken and assayed, showing a gold content of only about 50c. per ton. The deposit is, however, interesting as adding to the interrupted line of precious-metal deposits along the east base of the Sierra Nevada, and the metal contents here, as at the Wilshire mine, are evidently derived from the granodiorite magma.

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[1] *Prof. Paper* 62; U. S. Geol. Surv.

[2] *Trans.* Am. Inst. Min. & Met., Vol. LXVIII.

[3] Truckee folio, U. S. Geol. Surv.

Marketing Sodium Nitrate

Production and Prices Are Under the Control of Chilean Producers

By Charles H. MacDowell
President, Armour Fertilizer Works, Chicago

NITRATE OF SODA is a crystalline salt extracted from sedimentary rocks and gravels. The only deposit of commercial value in the world is found in a narrow valley lying between the low Coastal Range and the Andes, in northern Chile. Nitrate of soda was discovered in Chile as early as 1809, but was not prepared in commercial form until 1825. Since then a total of more than 65,000,000 tons has been manufactured. It has been estimated that in the zone of nitrate-bearing grounds so far examined by the Chilean Government, there is sufficient nitrate to supply the world's requirements for a hundred years. The unexplored area in Chile is considerably larger than the examined area, and is believed to contain requirements for an additional hundred years.

Nitrate deposits in Chile form the principle source of revenue for the Chilean Government. At present there are approximately 150 producing works with about eighty different owners. Their total capacity is in excess of three million tons a year. According to the U. S. Department of Agriculture's investigation, the nationalities of the ownership of the oficinas from a producing standpoint are about as follows: Chilean, 61½ per cent; British, 36 per cent; United States, 2½.

With their revenue derived almost exclusively from the export tax on nitrate, it is quite evident that the Chilean Government exercises a very wide influence in the manufacture and distribution of the oficinas' production, and the propaganda work of the Producers' Association in Chile has been extremely effective.

The principal uses of nitrate of soda are for the manufacture of commercial fertilizers, for direct application to the soil as a top dressing, for the manufacture of explosives, and for the manufacture of chemicals.

There are two distinct grades of nitrate of soda—namely, Ordinary, which is guaranteed to contain 95 per cent of nitrate, and Refined, basis 95 per cent nitrate and 1 per cent salt. In certain deposits in Chile there is a third grade called Potash Nitrate, containing about 30 per cent to 40 per cent of potash, but the output of this grade is not important.

Before the World War the producing companies at different times tried to fix prices, but were never successful over a long period. Nitrate was sold through an exchange in Valparaiso, and the market fluctuated from day to day according to demand. During the war the Allied governments bought the entire production in Chile and regulated both the price and distribution. After the war the producing companies owning the oficinas, with the exception of the American producers, formed the Chilean Nitrate Producers' Association for the purpose of fixing prices and allotting shipment quotas to the different members. They were also in charge of propaganda work, and assessed the members to carry on this important feature. At the time of its formation in 1919 it was generally predicted that it would be impossible to hold the members of the association together, owing to the fact that production exceeded exportation; but so far the association has functioned very smoothly, and there is every reason to believe that it will continue to exist.

At this time the association in Chile publishes a price in May, effective for the ensuing twelve months. The price is based on free-alongside-vessel Chilean ports, in shillings and pence, per metric quintal of 100 kilos (220.46 lb.). The Chilean Nitrate Association's prices for the last two years and for 1924 and 1925 follow:

	1922–23 s. d.	1923–24 s. d.	1924–25 s. d.
First half July	18 6	19 3	19 3
Last half July	18 9	19 3	19 3
First half August	19	19 5	19 5
Last half August	19 3	19 7	19 7
First half September	19 6	19 9	19 9
Last half September	19 9	19 11	19 11
First half October	20	20 1	20 1
Last half October	20 2	20 3	20 3
First half November	20 4	20 5	20 4½
Last half November	20 6	20 7	20 6
First half December	20 8	20 9	20 7
Last half December	20 8	20 11	20 8
First half January	20 8	21	20 9
Last half January	20 8	21	20 9
First half February	20 8	21	20 9
Last half February	20 8	21	20 9
First half March	20 8	21	20 9
Last half March	20 8	21	20 9
First half April	20 8	21	20 9
Last half April	20 8	21	20 9
First half May	19 9	21	20 9
Last half May	19 9	21	20 9
First half June	18 6	21	20 9
Last half June	18 6	21	20 9

An allowance is made from these prices of from 0.7 per cent to 0.9 per cent for tare, depending upon the size of the bags shipped. Material is usually shipped in jute bags weighing from 80 to 90 kilos.

To arrive at the cost price delivered American ports it is necessary to add the freight of from $5 to $6 per ton of 2,240 lb., insurance, loading and sampling expense, and brokerage.

Until after the war the oficinas used coal for fuel, which was shipped from England and America. For the last five years, however, they have been using oil, which has lessened the number of ships available for return cargoes and consequently made freights higher.

Buyers from the association usually pay for the material on ninety days' draft on London.

Of the 889,009 tons imported into the United States last year, as near as can be determined 60 per cent was used in the manufacture of complete fertilizers or sold direct to the consumer for agricultural purposes, and 27 per cent was used by the explosives trade and 13 per cent by the acid and chemical manufacturers.

The importation and sale of nitrate of soda for United States consumption is handled by four different companies, three of which have offices in New York, and one of which has headquarters in Wilmington, Del. Two of these importers are owners and charterers of steamers, and use the nitrate tonnage to provide return cargoes for the vessels which they send to Chile with merchandise. One of the importers is a manufacturer of explosives. The fourth importer represents a London banker who has banking and commercial interests in Chile. Two of the importers own oficinas, but they are not permitted by United States law to belong to the association.

The importers sell to interested buyers for delivery

by months, in such quantities as the buyer requires at the different ports, on a strictly competitive basis. Prior to the war it was the custom of the importers to bring in large quantities at different ports and store for the accommodation of buyers. Since the war, however, storage rates and the expense of handling have been so great, and the margin of profit has been so small, that the importers bring in very small amounts of unsold tonnage to different ports, although at important ports like New York, Baltimore, Savannah, and New Orleans the buyer can secure deliveries from store at almost any time of the year on short notice.

There is a good consumption of nitrate in California, with San Francisco as the principal distributing port. Hawaii is also a large consumer, cargoes going direct. The recognized ports for distribution of nitrate are Boston, New York, Baltimore, Pensacola, Mobile, New Orleans, Norfolk, Wilmington, N. C., Savannah, Charleston, Jacksonville, and San Francisco.

The average prices for nitrate per hundred pounds at New York from 1917 to 1923 inclusive are given below. The figures for the year 1913 are also given, for purposes of comparison:

	1913	1917	1918	1919	1920	1921	1922	1923
January	$2.57½	$3.20	$4.50	$4.42	$3.07½	$2.85	$2.34½	$2.57½
February	2.65	3.60	4.50	4.35	3.55	2.80	2.39½	2.60
March	2.57½	3.70	4.50	4.07½	3.87½	2.85	2.63½	2.60
April	2.57½	3.75	5.40	4.07½	3.92½	2.75	2.80	2.60
May	2.40	3.70	5.40	4.07½	3.85	2.87½	2.70	2.55
June	2.37½	4.05	4.05	4.07½	3.85	2.67½	2.60	2.42½
July	2.32½	4.20	4.10	2.97½	3.87½	2.32½	2.50	2.42½
August	2.30	4.25	4.32½	2.97½	3.87½	2.17½	2.40	2.43
September	2.30	4.65	4.32½	2.90	3.65	2.20	2.37½	2.43½
October	2.25	4.85	4.40	2.97½	3.07½	2.32½	2.42½	2.47½
November	2.20	4.80	4.40	3.00	2.95	2.22½	2.45	2.47½
December	2.15	4.60	4.42½	3.02½	2.87½	2.20	2.55	2.48½

Usually, little difference exists in prices for deliveries at the different ports on the Atlantic and Gulf coasts. The only time there is any variation is when a shortage occurs at some particular port for spot delivery. Importers usually ship in cargo lots between 6,000 and 10,000 tons. Occasionally, a boat will be discharged at two or three ports. Prior to the war, when nitrate was sold on the Valparaiso exchange at a fluctuating price, some of the large users of nitrate occasionally bought material f.a.s. Chilean ports and arranged for the importation themselves. Under present conditions, with four importers competing for business and with their facilities for handling small lots, there is no economy in the large buyer doing his own importing, although this would be easily possible if anything should come up to prevent the present distribution method.

Nitrate of soda in the United States is quoted by the importers per 100 lb. ex-vessel seaboard; terms, cash against documents. Importers furnish Valparaiso certificate of analysis and weights at time of discharge. On ordinary nitrate—that is, 95 per cent grade—a pro-rata allowance is made for underrun in analysis, but no producer could expect to do business unless the analysis of his nitrate ran uniformly up to 95 per cent. On the 95 per cent grade, which is used more for chemical and acid manufacture, 96 per cent is guaranteed, with a 1 per cent maximum of salt. Potash nitrate usually runs about 18 per cent ammonia and 12 per cent to 16 per cent K_2O, and is quoted on the basis of either so much per hundred pounds for the nitrate or so much per unit of K_2O for the potash, or in some cases is sold on a flat ton basis. One difficulty in handling potash nitrate is the variation in analysis of the K_2O, which makes it difficult for the fertilizer manufacturers to figure accurately for their formulas.

Most of the nitrate of soda consumed by the fertilizer industry is used during the months of January to May inclusive. The powder and chemical trades use the nitrate throughout the year in fairly uniform quantities.

A large part of the nitrate used in agriculture is sold for direct application to the soil. On account of its peculiar chemical composition, nitrate has never been considered from a manufacturing standpoint on a strictly competitive basis with sulphate of ammonia. Experience has shown that the best results can be obtained in certain localities and on certain crops from the use of nitrate, and even though synthetic ammonia is eventually produced at a cheap cost, there will always be a demand for nitrate of soda for certain crops and soils. It is a quicker form of nitrogen than sulphate of ammonia, and is especially valuable in forcing early growth. It is mixed with the slower forms in commercial fertilizers.

In shipping nitrate of soda in box cars the railroad requires that special "Inflammable" labels be tacked on each side and each end of the box car so loaded. Nitrate of soda is handled in burlap bags. The bags as shipped from Chile are not of even weight; they generally vary as much as five or ten pounds to the bag. Some of the buyers of nitrate insist on even-weight bags, in which case the importer arranges at port of discharge for the bags to be even weighted, for which a fee of $1 per ton extra is usually charged.

Insurance regulations require that nitrate of soda be stored in separate fireproof warehouses. A greater quantity than that required for the day's mixing will not be allowed to be kept in the factory. This regulation has had a tendency to cause the manufacturers to use nitrate on a hand-to-mouth basis, and for this reason the service rendered by the importer permits buying of nitrate as required, without the necessity for storing large quantities.

In 1913 the world's consumption of nitrate of soda was 2,555,852 tons. The decrease between 1913 and 1921—barring the 1917-18 large war consumption—was due to the loss of German business. Before the war Germany was the largest consumer of nitrate of soda; during the war the Germans were dependent on synthetic sulphate of ammonia for their supply of nitrogen. During the last year, however, a total of 40,000 tons of nitrate of soda was shipped to Germany, as for certain crops and certain soil conditions nitrate was found to be more desirable than sulphate of ammonia.

Figures for the twelve months ended Dec. 31 for the past three years relative to production in Chile, exports to Europe, the United States and other countries, stocks in Chile, and other details, in tons, follow:

	1923	1922	1921
Production	1,874,000	1,035,000	1,294,000
Exports to Europe (including Egypt)	1,159,000	557,000	715,000
Exports to United States	899,000	578,000	302,000
Exports to other countries	164,000	137,000	80,000
Deliveries in Eurpoe (including Egypt)	1,063,500	1,000,500	635,000
Deliveries in United States	915,000	732,000	238,000
Deliveries in other countries	171,000	116,000	78,000
World's consumption	2,139,000	1,841,000	1,313,000
Stocks in Chile	916,000	1,231,000	1,441,000

The Department of Commerce has made exhaustive investigations of the Chilean nitrate costs, and has concluded that if necessary it would be possible to reduce present costs in Chile by a little over $12 per ton and still leave the owners an ordinary profit. Recoveries of nitrate from the matrix (caliche) under present methods of extraction are poor, averaging around 60 per cent. Newer methods are being tried out, and a 90 per cent recovery is indicated. The installation of larger recovery methods should materially decrease the cost of manufacture and lengthen the life of the fields.

Metallurgical History of the California Rand

Original 100-Ton Flotation Mill Enlarged to 200 and Then to 400 Tons in Record Time to Take Advantage of Pittman Act

By Murray N. Colman
Metallurgist, California Rand Silver, Inc., Randsburg, Calif.

Murray N. Colman

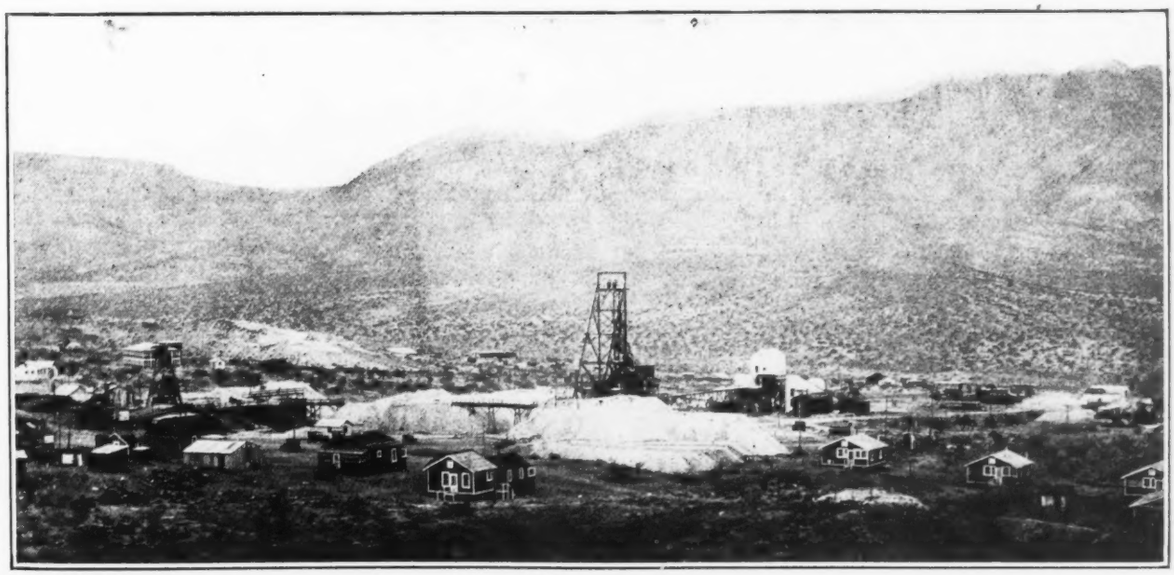
THE California Rand silver mine was discovered in May, 1919; by June, 1921, high-grade ore to the value of $3,000,000 had been shipped—as it came from the mine; it was not even hand-sorted. In fact, the first carload or two was hardly clean of sage brush. In these preliminary operations a considerable amount of low-grade material was blocked out but not mined, except when it was necessary to do so to reach the ore of shipping grade. About 25,000 tons of 20-oz. ore was handled in this manner.

In May, 1921, the company decided that sufficient low-grade ore was available (about 100,000 tons, averaging 20 oz. or more) to warrant the erection of a 100-ton mill. The sum of $150,000 was set aside from the net returns of ore shipments for that purpose. I was engaged as metallurgist and given carte blanche in the matter; no suggestion or recommendation was made by any of the directors; I was free to work out the problem as I saw fit. It was hoped that the mill could be built by Jan. 1, 1922. In addition, two reasonable requests were made: that the total cost would not exceed the sum appropriated, and that, above all things, the mill be a success.

How the adoption of that policy facilitated our task can be appreciated by those who, like myself, have usually been accustomed to a management that has more confidence in its opinions as to detail than it has in the decisions of the man selected to do the work. It is my belief that the California Rand company is satisfied with the results of its policy in this respect; but I wish to state that success was due largely to its confidence in the men employed. All worked for a common goal with equal persistence; and much was accomplished in a short time and at a minimum of expense.

On arrival I found that samples of the ore had been submitted to engineering firms, most of whom suggested flotation. In addition to recommendations that were sound, the company received many attractive reports the adoption of which would have meant disaster, rich as the mine has proved to be. Many of the samples sent out were of a composite nature, made up of 20 per cent oxidized and 80 per cent sulphide ore, by weight. I did not approve of this; to me the main problem appeared to be one that involved the treatment of straight sulphide ore. The oxidized material could be taken care of as a secondary consideration, only, perhaps, to be treated in the sulphide plant when the time came.

Samples had been sent to Hamilton, Beauchamp & Woodworth, of San Francisco, about two weeks prior to my taking over the work. I got in touch with Mr. Beauchamp immediately, and we outlined a procedure of investigation, on the findings of which I intended to base the final decision. Every effort was made to avoid



The California Rand Silver at the center, with Randsburg Silver at the left

the adoption of flotation, on account of the royalty charges of 2½ per cent of gross production; but our efforts proved abortive. No treatment or combination of treatments equaled the results obtained by flotation; hence its adoption. The royalty charge appeared unreasonable; but after computation on an alternative basis it faded into insignificance, compared with other costs. For every million dollars' worth of product, the royalty amounted to only $25,000. This was a small charge compared to freight rate or treatment cost; and it was evident that we were wasting time trying to save about 50c. per ton, when the freight to the smelter and treatment there involved a cost ten times as much as the royalty on the same amount, and was much in excess of a reasonable charge. To illustrate: One consignment of high-grade ore, containing 61,968 lb. net, assayed 1.4 oz. gold, 1,336 oz. silver, 5.1 per cent arsenic, and 5.8 per cent antimony. Deductions and charges per ton were as follows:

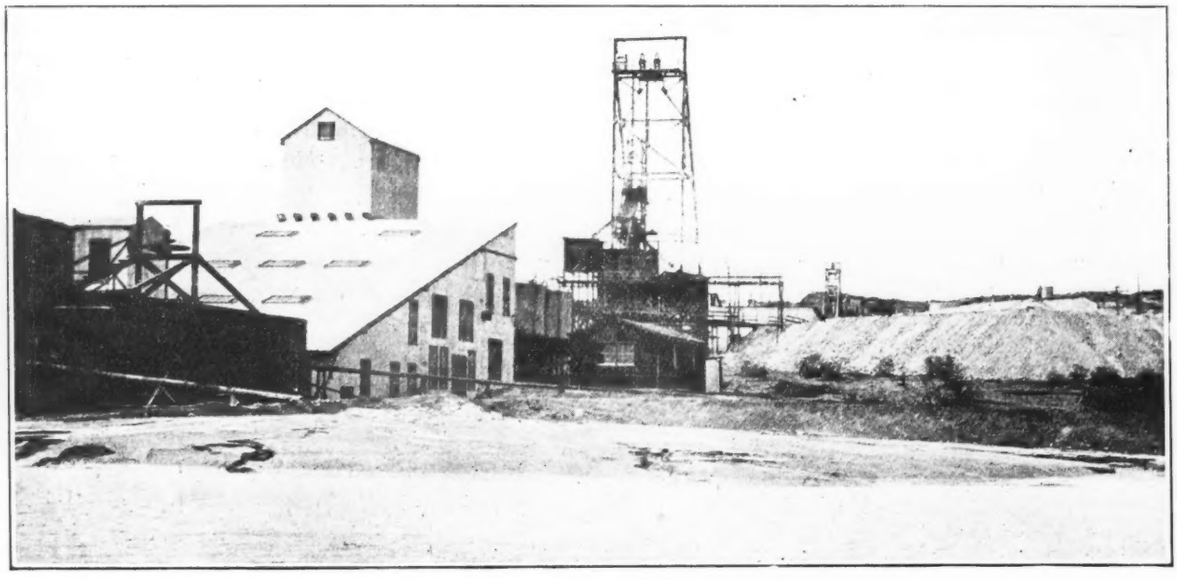
Penalty on arsenic and antimony	$19.80
Treatment charge	14.00
5 per cent of the silver	66.56
5 per cent of the gold	2.36
Freight	32.60
Tax	1.00
Total cost per ton	$136.32

It will be seen that the factor of freight-treatment cost demanded primary attention; and subsequent experiments which we conducted on a large scale proved that this lot of ore could have been treated for about $30 per ton, including the cost of refining and marketing the bullion.

Flotation being decided on, I advised the company to sign a license agreement with Minerals Separation. This precluded the possibility of litigation, permitted the use of the M. S. machine, which I favored, and placed us in a position to receive the benefit of new improvements developed by the licensing company. I am frank to admit that we have received valuable service in more than one instance, and no regrets are entertained that the license was signed. The California Rand company has paid over $40,000 in royalties since the mill started, and the arrangement has been one of mutual benefit. Royalty charges have since been reduced from 2½ to 1½ per cent.

The selection of a flow sheet was influenced by a desire for simplicity, keeping in mind the possibility of increased capacity later. Each unit of the mill was calculated on a basis of 25 per cent over the nominal 100 tons expected to be handled; ore to be treated was assumed to be hard. The rock crusher and elevator section was designed to handle 200 tons in eight hours, which permitted crushing to be done on the day shift, with a margin of time for repairs. In the event of increased capacity, two shifts would be sufficient.

Ample bin capacity was provided between mine and mill, which permitted the mill to run several days in the event of interruption of output from the mine. Owing to local topography it was necessary to install a 60-ft. bucket elevator to insure a gravity flow through the mill circuit. The ball-mill floor required a 12-in. fill; the tube-mill floor was cut 3 ft. below grade, and the flotation floor was excavated 5 ft. below grade. This was justified because the mill was situated in a desert country; there was little danger of flooding the lower bay with rain water. The appearance of the mill from the outside is not attractive, but the interior presents a different aspect. We may be criticized for having too large a building and too much floor space for the amount of equipment used, but the arrangement indicates a tremendous advantage over a crowded mill.



Mill and headframe of the California Rand Silver

So far as possible, and where all features were considered equal, we purchased mechanical equipment from local manufacturers, to insure getting replacements promptly. This also permitted construction and mill operation to be started at the earliest possible moment, and time meant money during the life of the Pittman Act. On a 100-ton basis with 20-oz. ore the difference in profit amounted to about $600 per day, depending on whether the selling price was $1 or 62c. per ounce. On a 200-ton basis, it amounted to $1,200 per day; and on a 400-ton basis, to $2,400 a day. In other words, it cost the California Rand company $1.66 in profit for every minute of running time lost in the

mill. At least, that is the condition that prevailed for the first five months of 1923.

I was in favor of contracting the construction of the mill, so the work was turned over to John Cahill, of San Francisco. Such a method is so much cheaper than doing the work by day labor that it is surprising that so few mining companies adopt it. Under ordinary conditions the organization of an efficient crew is never accomplished. Every wood-butcher that comes along claims to be a full-fledged millwright, and he has spoiled something before he is fired. The work often drags because an attempt is made to lengthen the time of construction. By contracting the work, an efficient and organized crew of skilled mechanics is available, in charge of an intelligent foreman who is almost as familiar with the operation of the plant as you are. The men engaged are high priced, so to speak, but cheap in the long run, because they know what they are doing and because every move counts. There is no incentive to delay completion, because another job is usually awaiting them.

Excavation for the California Rand mill was started on Aug. 15, 1921, and the mill was completed on Dec. 3, or in 112 days. The cost was $87,000. This meant that the work was completed twenty-six days ahead of the time requested, and at a cost of 58 per cent of the amount appropriated. We had a neat, spacious, well-lighted mill with concrete floors and plenty of room. A sketch of the original flow sheet is shown herewith, Fig. 1.

The mill was started for one shift per day, on Dec. 4, 1921. The mechanical features were as near perfect as they could be; but difficulty was experienced in the flotation department. This was due to lack of trona in the circuit, the actual requirements proving to be more than triple the amount estimated. Soon after obtaining our balance we reached a 90 per cent recovery on $13.95 feed. We treated 1,518 tons during the first month.

In January, 1922, the second month of mill operations, we experienced difficulty owing to weather conditions. It was the worst winter known in these parts for thirty years, and of course we were not prepared for it. For days we were busy thawing pipes and pumps. We kept running, although no records were made. This unfavorable condition prevailed off and on for five months. During April a few minor changes were made in the flow sheet that permitted us to mill 150 tons per day. One more classifier was added to take the discharge of the ball mill; and the oversize was sent to the tube mill instead of back to the ball mill after screening through a trommel. This did away with one 5-hp. motor, an elevator, and a trommel screen, and permitted the ball mill to run on uncrushed ore to its full capacity. The scheme worked well; and, as no difficulty was experienced in supplying the additional tonnage, further expansion was planned. By installing a secondary crusher, we were able to deliver a finer feed to the ball mill; and by September we were treating 200 tons per day, the cost of the entire mill being $100,000, or 75 per cent of the amount appropriated for the original 100-ton mill.

Expansion became a habit. It was evident that the end of $1 silver was in sight—another year at the most; and as there was sufficient ore in the mine even on the 200-ton-per-day basis, I was in favor of duplicating the entire mill, making two units of 200 tons each. We had worked out a scheme by which we could do the work in a short time and at an astonishingly low cost. When these figures were submitted to the directors, we were authorized to go ahead. The meeting was held on the evening of Nov. 3, 1922, and I had promised to have the second unit built and running by Jan. 1, 1923, or in fifty-eight days, at a cost not to

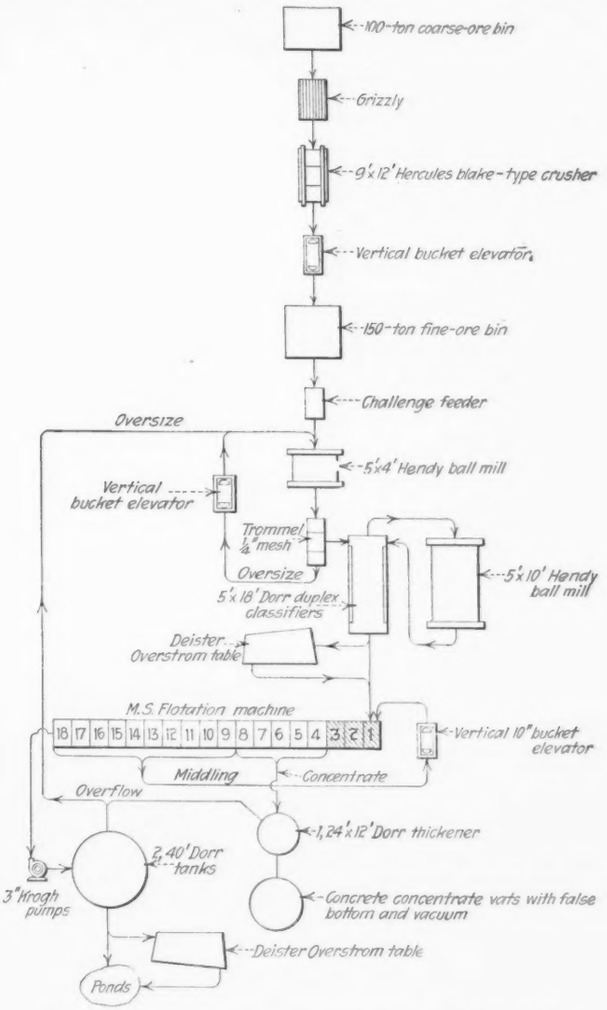
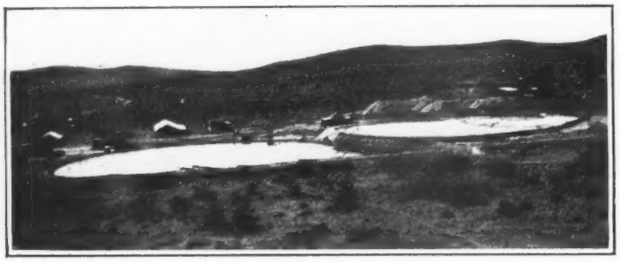


Fig. 1—Flow sheet of the original 100-ton unit

exceed $60,000. I was so sure of the ultimate profits to be derived from the second unit that I had committed myself deeply.

The following is a summary of the work on the second unit: Nov. 4, 1922, excavation work started; Nov. 18, fourteen days, excavation work and building completed; Dec. 7, foundations and all concrete work completed; Dec. 23, machinery in place and motors installed; Jan. 1, 1923, mill started at 9 a.m. Time of construction, fifty-seven days (Christmas off and no night work). Cost of unit, $57,633. The crushing mills were manufactured and delivered by the Joshua Hendy Iron Works Co., of San Francisco, in thirty-five days after order.

This second unit treated 5,575 tons of ore during January, 1923, and returned a profit of $40,000 over the cost of treatment. By March 1, the second unit had more than paid for itself; and by June 1 (expiration of $1 silver) the second unit had paid $185,000 more profit by milling ore during the $1 silver period than it would have done with silver at 63c.



Slime settling ponds

It is interesting to note the expansion from the standpoint of concentrate production and gross value. The following figures have a pronounced curve line:

	Tons Concentrate	Gross Value
December, 1921 January, 1922 February, 1922 March, 1922	142.5	$60,290
April, 1922 May, 1922 June, 1922	315.0	131,868
July, 1922 August, 1922 September, 1922	642.1	211,884
October, 1922 November, 1922 December, 1922	871.2	313,215
January, 1923 February, 1923 March, 1923	1,310.7	439,830
April, 1923 May, 1923 June, 1923	1,730.8	449,320

From the time of starting until July 1, 1923, the mill treated 125,000 tons of ore, and produced 5,012 tons of concentrate having a gross value of $1,606,408. The entire cost of the mill as it stands on the books of the company is $197,000. This includes three miles of pipe line and pumping equipment for water supply, which cost $20,000, and two storage warehouses and incidentals, the cost of which aggregated $10,000.

The conditions governing the metallurgical practice are chiefly economical. A high recovery was maintained so long as physical conditions were under control, but at times unusual problems have arisen, and we have been obliged to accept losses that might call for criticism. When the first 100-ton mill was installed the only available supply of water was from Hinkley, a station on the main line of the Santa Fé railroad, 60 miles from Randsburg. It was hauled in tank cars, and cost 0.3c. per gallon. We anticipated using about 50,000 gallons per day, at a cost of $150, or $1.50 per ton milled. It was not the cost that worried us so

Detail of Flow Sheet (Fig. 2)

1, Run-of-mine ore in cars.
2, Trona storage.
3, 200-ton receiving bin.
4, Two 20,000-gal. stock tanks (20 ft. dia. x 12 ft. cor. iron).
5, Grizzly, 6 ft., set at 1 in.
6, Blake crusher, 10 in. x 16 in.; set at 1½ in. (Manufactured by the Joshua Hendy Iron Works. Weight, 10,200 lb.; price: $1,250).
7, Elevator: 61 ft. (12 in. buckets set 16 in. apart).
8, 100-ton intermediate storage bin.
9, Grizzly: 6 in. (set at 1 in.).
10, Dodge crusher: 9 in. x 15 in.; set at 1 in. (manufactured by Allis-Chalmers. Weight 12,750 lb.; price, $1,593).
11, Elevator: 50 ft. (10-in. buckets spaced 16 in.).
12, Flotation oil storage and mixing tank.
13, Boiler (for heating pulp in winter). Frost 50 hp., oil fired.
14, Trona bin. (Set inside of mill bin.)
15, 200-ton mill bin.
16, Conveyor-feeder. (Johnson feeder).
17, Hamill ore feeder feeding trona.
18, Hamill ore feeder. (Weight, 600 lb.; price, $200.)
19, Anaconda-type oil feeder.
20, Oil pump.
21, Hendy ball mills: 5 ft. x 4 ft. (Manufactured by Joshua Hendy Iron Works. Weight, 25,000 lb.; price, $3,650).
22, Flotation reagent drip tanks.
23, Hendy tube mills; 5 ft. x 10 ft. (Manufactured by Hendy Iron Works. Weight, 40,000 lb.; price, $6,135.)
24, Dorr type "C" 18 ft. duplex classifiers.
25, Dorr type "C" 14 ft. duplex classifiers.
26, M. S. flotation: 18-cell standard type.
27, M. S. flotation: 6-cell new type.
28, Dorr 30-ft. thickener. (Concentrates.)
29, Elevator: (6-in. buckets spaced 12 in.)
30, M. S. flotation: 24-cell new type.
31, M. S. flotation: 6-cell new type.
32, Middling distribution box.
33, Two Krogh No. 3 middling pumps (one in reserve).
34, Middling sump.
35, Overstrom Universal table. (Pilot to indicate sulphide loss in flotation.)
36, Table concentrates settling box.
37, Two Wilfley sand pumps; No. 4 (one in reserve). Price, $550.
38, Tailing sump.
39, Two Krogh No. 3 pumps. (Return water circuit. One in reserve.)
40, Return water collecting tank.
41, Concentrate filter and dry floors.
42, Concentrate warehouse.
43, Nine Dorr thickeners (tailing may be split in series, parallel, or groups).
44, Settling pond (an optional circuit necessary at times).

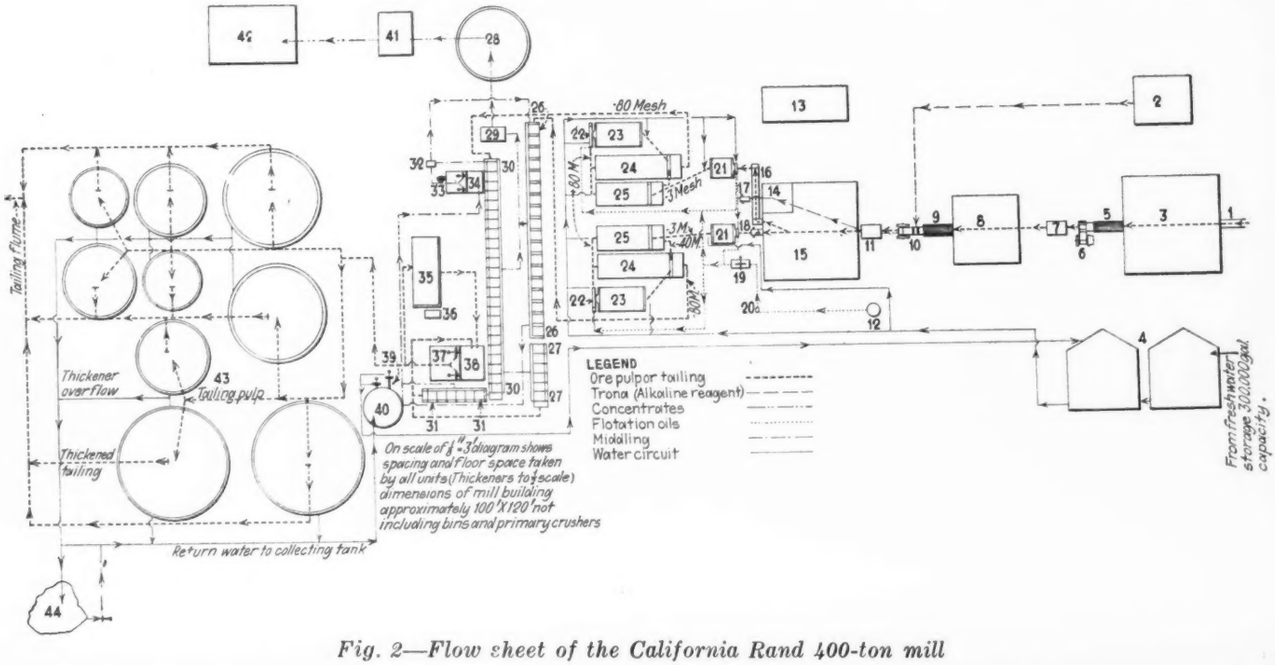


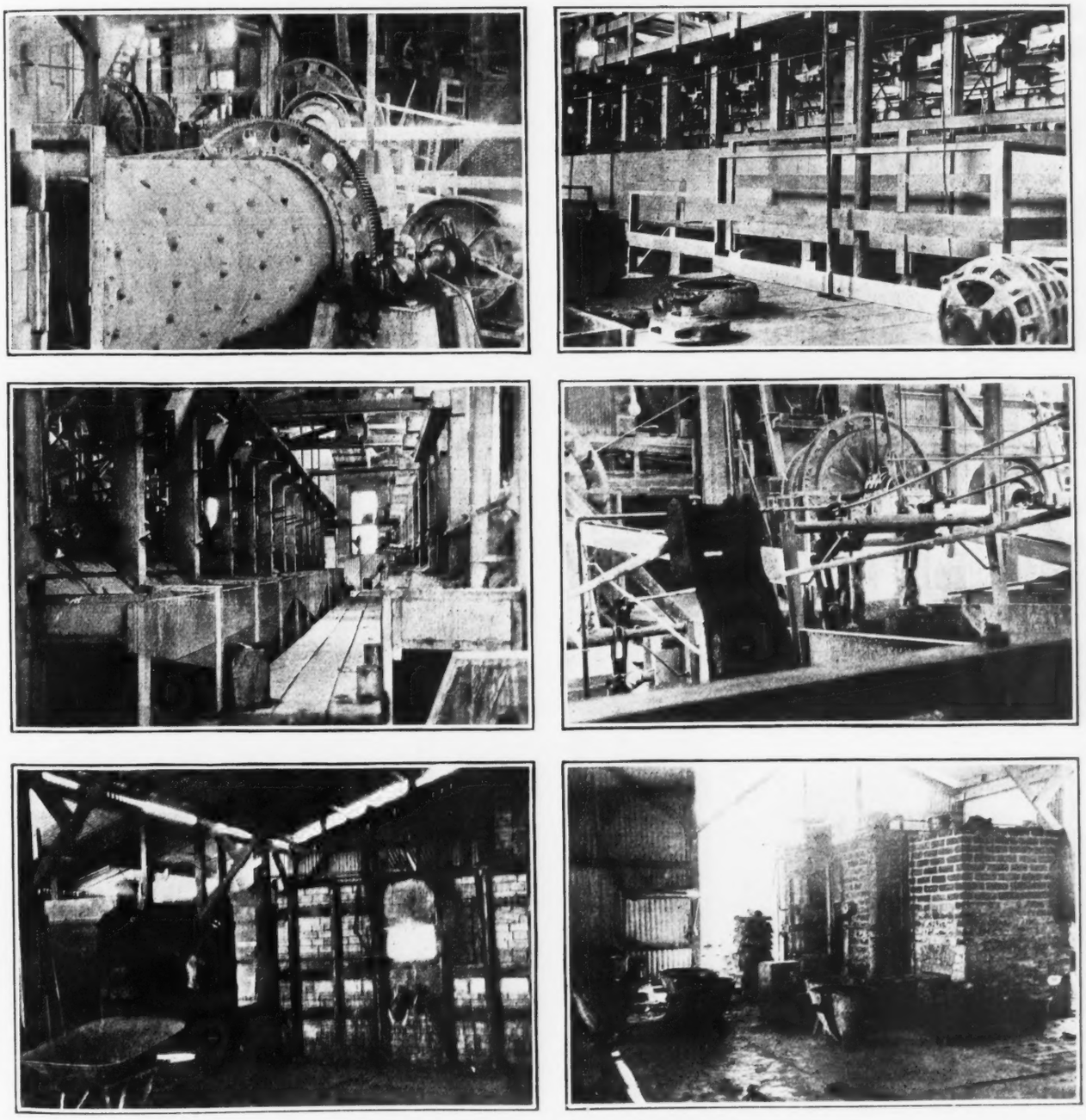
Fig. 2—Flow sheet of the California Rand 400-ton mill

much as a guaranteed supply; and, when we were short, a not infrequent occurrence, we were obliged to mill with dirty return water, which resulted in increased tailing loss. The mill could have been shut down at such times; but, as I stated before, time meant money, and it was cheaper to accept a tailing loss of $3 or $4 per ton than one of 42c. per minute for lost time.

Suitable Water Supply a Problem

The nature of the ore, largely decomposed schist, complicated the water question. The ground pulp was highly colloidal, a condition that was aggravated by the addition of trona to deflocculate the slime. Such a mixture refuses to settle. In the original flow sheet two 40x12-ft. Dorr thickeners were installed with the belief that the settling area would be sufficient, but these proved inadequate and two large ponds were added. Clear water was obtainable from these in the absence of wind; or only in the summer time. Moreover, evaporation losses from these ponds amounted to 15,000 gal. per day. Filtering was considered, but the idea was discarded after repeated attempts. Attempts to break down the colloidal condition were successful, but at a prohibitive cost.

The water crisis was passed after six months of grief; an arrangement was made with the Yellow Aster Mining Co., whereby 80,000 gal. per day were obtained. We laid a 3-in. gravity-flow pipe line from the Yellow Aster mine to ours, a distance of three miles. When the mill capacity was increased to 400 tons it was necessary to place a large pump on this line to deliver 160,000 gal. per day. The Yellow Aster wells, about 15 miles from Randsburg, are more than 2,000 ft. deep and can produce 350,000 gal. per day.



Interior views of the California Rand mill

The disposal of tailing has proved no easy task, owing to the flatness of the country. At first we impounded it by building up the lower section of the ground, but even with 100 tons per day the method was expensive. Could we have filtered, it would have been an easy matter to stack it. Finally we conceived the idea of taking advantage of the colloidal condition of the fine particles in the pulp. The tailing is now discharged, with 50 per cent moisture, into a wooden flume having a 2½ per cent grade, and run to waste. The colloidal matter acts as a lubricant, and the sand particles float. The tailing will pass an 80-mesh screen, and 64 per cent will pass a 200 screen. It may seem strange that we should use water as a means of disposal, in view of its high cost; but this has been carefully computed, and the decision involved consideration of several factors. In the first place, a higher extraction is made when using fresh water, and this difference almost offsets the cost alone, providing, of course, a sufficient supply is available. Moreover, on a return-water basis, it is necessary to increase the amount of reagents. In all, it is cheaper to lose the water.

Filtration and Drying Equipment Being Installed

The third problem was the handling of the concentrate, which failed to respond to any filtering process. This problem under the 100-ton basis was not so difficult as it was later when the output of concentrate rose to 200 tons per day. On being discharged from a 30x12-ft. Dorr thickener the concentrate contains about 27 per cent moisture. This is run to leaching tanks to drain until about 20 per cent moisture remains, after which it is shoveled out and spread on mats to dry. The climatic conditions are favorable for this procedure in summer, but considerable trouble results in winter. After two years of experimenting, we find that this has been due to the use of trona, which dissolves the silicates in the ore. The product, combined with the decomposed schist, prevents filtering. By adding a small quantity of aluminum sulphate, the silica is precipitated as a hydroxide and the coagulated material forms a porous mass that will filter rapidly. We are now completing the installation of an American filter and a Lowden drier, by which further trouble will be avoided.

The present milling practice does not differ greatly from that originally adopted. We began by using crude and refined naphthalene, but have since changed the oil combinations, thereby saving $125 per day and securing a higher recovery. Trona is still used as an alkaline medium, but we are experimenting on a substitute for this. It was adopted in preference to soda ash, for several reasons. It costs $12 per ton, whereas soda ash costs $40 per ton. It has been our experience, moreover, that trona is superior to soda ash, because of the bicarbonate content. Recovery comparisons indicate a gain of 3 per cent in favor of trona. The following oils and reagents are used: Trona, about six tons per day, depending on the acidity of the ore; water-gas tar, dissolved in common distillate; Remoh—Hercules pine oil.

The flow sheet (Fig. 2) requires little explanation. Recovery has always been high, even in the face of adverse conditions. As stated before, the metallurgical work has been a matter of economics. Our milling cost when we first started was $5 per ton, and is now less than $2 per ton, including water at 60c. per ton. This reduction was brought about by the provision of an alternative water supply, by increased tonnage, change in oils used, and reduced labor costs. Owing to the simplicity of the mill it requires only two men per shift, the same as when crushing only 100 tons. High running-time efficiency is attributable to the same cause.

Fig. 3 represents the history of the mill in time efficiency, per cent recovery of gold and silver, mill

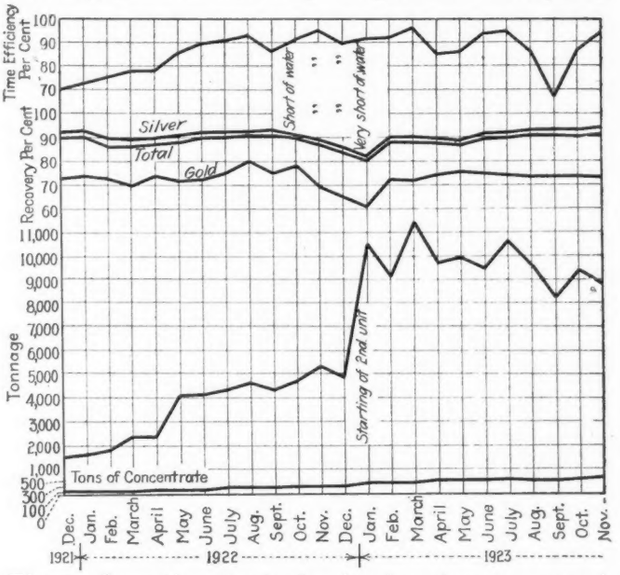


Fig. 3—Operation chart, showing how tonnage, operating time, and percentage of recovery varied, by months

feed, and concentrate tonnage. Fig. 4 represents a normal run, that of November, 1923. During this run, an attempt was made to introduce a substitute for trona, from Nov. 14 to 19. The results were not satisfactory, as the chart shows.

In February, 1924, the highest recovery reported up to that time for any month in the history of the mill was made, but conditions which then obtained are expected to continue. The following is a summary of the mill data for that month:

Mill Operations Month of February, 1924

			Tons
Total ore milled			4,668
		Tons	
Daily average, twenty-nine days		162	
Daily average, actual running time		369.41	
Per cent running time			44.85
Per cent lost time			56.15
		Hr.	Min.
Cause of lost time			
Power			20
Repairs during ore shortage		84	25
Ore shortage delays		73	40
One-shift policy		232	22
			Cents
Average gold in mill feed	$2.07	Average gold in tailing	32
Average silver in mill feed	19.23	Average silver in tailing	49
Total average mill feed	$21.30	Total average tailing	81
			Per Cent
Average gold recovery			84.5
Average silver recovery			97.45
Total average recovery			96.20
Recovery per ton		$20.49	
Recovery on 4,698 tons			$96,262.02
Average concentrate value per ton		220.00	
Tons of concentrates produced @ $220			442
Tons of concentrates shipped			587.83
Net value of concentrates shipped			$128,347.50
Average value of concentrates shipped, per ton		$218.34	

Gold values are calculated at $20 per oz.; silver at 65c. per oz.

Lost running time includes the time lost with the one-

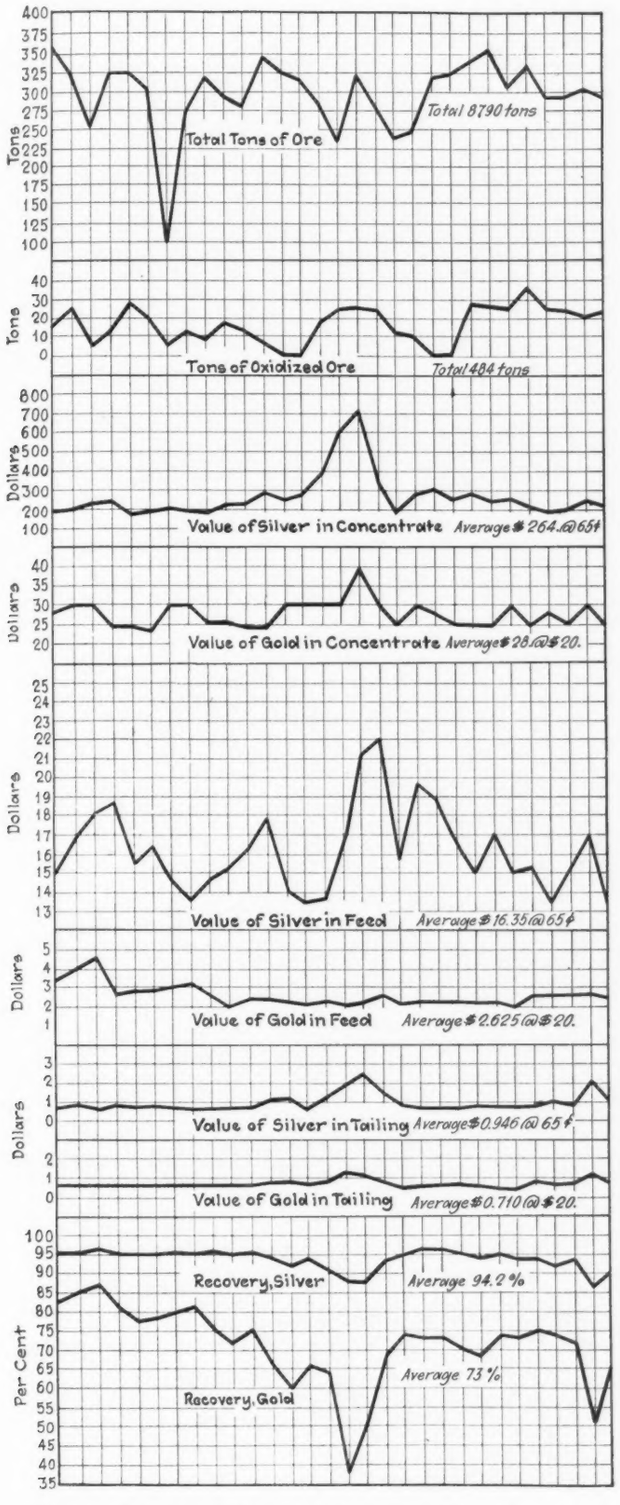

Tons
Total Tons of Ore
Total 8790 tons
Tons
Tons of Oxidized Ore
Total 484 tons
Dollars
Value of Silver in Concentrate Average $ 264.@65¢
Dollars
Value of Gold in Concentrate Average $ 28.@$ 20.
Dollars
Value of Silver in Feed Average $ 16.35@65¢
Dollars
Value of Gold in Feed Average $ 2.625@$ 20.
Dollars
Value of Silver in Tailing Average $ 0.946@65¢
Value of Gold in Tailing Average $ 0.710@$ 20.
Per Cent
Recovery, Silver Average 94.2%
Recovery, Gold Average 73%

Fig. 4—Daily metallurgical data for November, 1923

shift policy adopted on Feb. 16, during mine-development program.

Further changes are contemplated in the flow sheet, which should result in a still higher recovery. The last six cells that now compose the thirty cells on the No. 2 unit will be taken off; these will be placed in a different position in conjunction with six new cells, now on order; and to these twelve cells will flow the thickened tailing from the present Dorr thickeners. After this treatment the tailing will be discharged to waste. The benefit derived from this will be in the form of insurance, aside from additional recovery. If trouble occurs in the main mill, we will again have an opportunity to recover any loss resulting.

Going back to the reduction in costs, I omitted mentioning the saving made on the marketing of our concentrate, because it represents a cost by itself and involves no direct milling cost. As I stated in the beginning of this article, the marketing of the concentrate attracted my attention from the very first. To go into the details of our efforts in this connection would require a long description, which will be deferred until some future date. Suffice to say, we are now marketing the concentrate at a saving of $10,000 per month over the previous cost.

How Katanga Copper Gets to Market

Despite the fact that the method entails six separate haulings, there has of late been an increased tendency to ship copper from Katanga via Dar-es-Salaam, says the *South African Mining and Engineering Journal.* The copper goes first by rail to Bukama, on the Lualaba, thence by river steamer to Kabalo, again by rail from that point to Albertville, on Lake Tanganyika, by steamer across the lake to Kigoma, and once more by rail from Kigoma to Dar-es-Salaam, which is near Zanzibar. This is remarkable in view of the existence of a continuous rail route, over which the bulk of the Katanga traffic flows, connecting the copper belt with Beira, a seaport about 1,000 miles south of Dar-es-Salaam. The explanation appears to be connected with the fact that the railway from Beira to Katanga makes an immense detour via Bulawayo and the Victoria Falls, which adds nearly 600 miles to the distance traversed.

A considerable part of this superfluous distance could be eliminated by the construction of a cutoff from Sinoia to Kafue, and the bridging of the Zambesi at Kariba Gorge. The scheme has long been advocated, as it presents few engineering difficulties and would undoubtedly prove economical.

In view of the steady development of the Katanga mineral output, a correspondent of *The Times Trade Supplement* thinks the construction of the Sinoia-Kafue cutoff cannot be much longer delayed, and it seems probable that its early completion would insure for the Rhodesian railway system the maintenance of the bulk of the Katanga traffic for an indefinite period; whereas if matters are left as they stand, the Rhodesian system will run grave risks of losing a steadily growing proportion of this traffic to competing routes in existence or under construction.

New Shovels for Old

A local industry has sprung up in Johannesburg in remaking and repairing old and disused or broken shovels and spades from the Reef—the largest consumer of these goods in the world, says *The Ironmonger.* It is claimed that shovels rejuvenated by this new "hospital" last longer than new ones; and the number of "patients" sent in for treatment would seem to show that the convalescents have been good propagandists.

First the handle—usually broken—is unriveted and taken out of the socket. Then the blade has its worn tip cut off level, a row of holes drilled in it, and a new steel tip riveted on—at lightning speed. The repaired blade then goes to the wood-working shop.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Storing Natural Gas Underground

THE EDITOR:

Sir—Noting your description of the storage of oil in old oil wells, in Sarawak, it may be of interest to record the fact that for some years exhausted gas wells in Erie County, N. Y., have been in regular use as storage reservoirs for natural gas.

One of the notable gas formations of western New York is known as the "Flint" by the drillers. The term includes the Onondaga limestone, the Cobleskill dolomite, and the Bertie water lime, with a combined thickness of about 140 ft.

In one limited area, on the southern border of Erie County, this formation was found to be exceptionally productive, one well having an initial open flow of around 18,000,000 cu.ft. a day. The field was developed in 1907, but by 1918 the pressure had decreased to a point where it was putting little gas into the line against a line pressure of about 90 lb. to the square inch.

Near by, another gas field had been developed in the Medina sand, with high pressures. The Buffalo demands showed a wide spread between the summer and winter loads, and exceptionally cold weather put a load on the system which made the maintenance of satisfactory service difficult. The experiment was therefore tried of turning the summer surplus Medina gas into the old Flint wells, using the latter, with the partly emptied Flint, as a gas holder. The first experiment was the metering in of 45,000,000 cu.ft. of gas, all of which was recovered during the following winter as required. Later 350,000,000 cu.ft. were stored and recovered with 40,000,000 cu.ft. accretion from the rock. Since these tests the reservoir has held an important place in the natural-gas system which supplies Buffalo and other western New York towns. The gas thus stored is available in Buffalo within two hours of the opening of one valve, to care for excessive peak demands during the cold weather.

B. J. HATMAKER.

Buffalo, N. Y.

Treating Carbonaceous Gold Ore in Korea

THE EDITOR:

Sir—Your editorial "Carbonaceous Gold Ore Treatment," which appeared in the *Mining Journal-Press* on May 31, was of great interest to me. Our ore problem is very similar to that of the Ashanti Mines, so far as the presence of carbonaceous matter and arsenic goes, and I have discussed it in the technical press several times. (See "Concentration and Cyanidation," *Mining and Scientific Press*, Dec. 3, 1921; "The Cyanide Plant of the Nurupi Mines, Korea," *Engineering and Mining Journal-Press*, March 31, 1923). In our plant we overcame the difficulty by elimination of most of the carbon and other refractory material on Wilfley and canvas tables, preliminary to cyanidation. The extraction was thereby greatly improved.

At present I am engaged in some research work on the all-sliming treatment of the same ore, combined with agitation in cyanide solution and counter-current decantation, and the following table will indicate some of the results so far secured:

Cyanide Experiments on All-slimed Ore

	Experiment No. 1	Experiment No. 2	Experiment No. 3
Value of ore per ton, yen	17.04	17.04	17.04
Mesh	—200	—200	—200
Solution ratio	1:3	1:3	1:3
Strength of cyanide solution:			
Kg. KCN per ton of solution	1.95	1.95	1.79
Kg. CaO per ton of solution	0.82	0.82	0.68
Original gold content, yen	0.19	0.19	0.19
Time of agitation, hours	8	16	16
Consumption of chemicals:			
Kg. KCN per ton of ore	3.705	3.205	3.270
Kg. CaO per ton of ore	2.415	1.875	1.650
Gold dissolved per ton of ore, yen	11.25	11.40	12.57
Equal to, per cent	66.02	66.90	73.77
Gold extracted from ore, yen	11.24	11.77	12.53
Per cent	65.90	67.90	73.53
Average percentage extraction from pulp and solution	66.0	67.4	(!) 73.65

Note: Experiment No. 3 made with admixture of coal tar, 5 lb. to 1 ton of ore.

Even following the excellent ideas of André Dorfman expressed in his recent publication in the May *Bulletin* of the Institution of Mining and Metallurgy, addition of oil here does not improve the extraction to any great extent.

The large consumption of cyanide and lime seems to make all-sliming prohibitive.

On the other hand, it is interesting to note, as demonstrated in the following tabulation, that if concentration on tables is maintained, but the coarse concentrate is reground and then agitated, together with the slime concentrate produced on canvas tables, with cyanide solution, an extraction of over 90 per cent is obtained, and the cyanide consumption per ton of ore is only one-tenth of that incurred with all-sliming:

Cyanide Experiments With Reground Concentrate

	Experiment No. 1	Experiment No. 2	Experiment No. 3	Experiment No. 4
Concentrate value per ton, yen	30.23	30.23	30.23	30.23
Mesh	—0.1 mm	—0.1 mm.	—0.1 mm.	—0.1 mm.
Strength of cyanide solution:				
Kg. KCN per ton of solution	1.76	1.76	1.76	6.30
Kg. CaO per ton of solution	0.62	0.62	0.58	3.19
Time of agitation, hours	8	12	16	16
Ratio of solution	1:3	1:3	1:3	1:3
Consumption of chemicals:				
Kg. KCN per ton of ore	2.85	3.81	3.93	0.96
Kg. CaO per ton of ore	1.02	1.29	1.07	2.58
Gold extracted from concentrate, yen	24.49	24.93	25.43	27.27
Equal to, per cent	81.01	82.47	84.12	(!) 90.20

In my opinion one should never attempt to crush a carbonaceous gold ore in cyanide solution unless it has been proved that this can be done efficiently after inhibiting the precipitation effect of carbon by admixtures of oil, or other preventive means.

C. FLURY,
Mill Superintendent.

Care Chosen Syndicate, Taiyudong, Korea.

The Critic Criticized

THE EDITOR:

Sir—"In and Under Mexico" is a very interesting and highly readable book. It was of special interest to me, as I spent three years at Pilares, called Monte de Cobre in the book. While Mr. Ingersoll is correct in many of his statements, he leaves with the reader the wrong impression of both the Mexicans and the Moctezuma Copper Co., which owns the camp. He says that one family, and often two, occupy a single-room company house, all living together in this small space. He visited one of the contractors who was making good wages, and instead of a decent home found a little adobe hut, thatched with ancient iron salvaged from some scrap heap. The house, a one-room affair, which served as kitchen, parlor, and bedroom, was exceedingly dirty. He then goes on to describe the home of his helper, who earned much less money. Here, the one room served for two families instead of one and the dirt was twice as bad.

Mr. Ingersoll fails to mention any of the neatly kept Mexican houses in town, and there are many such. He fails to mention the homes of such men as Don Pastor Valenzuela, with flowers in the yard, and window boxes, and which are spotlessly clean, inside and out. My experience with the Mexican people has taught me that the women keep their homes cleaner than do American women who may occupy the same station of life.

So far as each family having only a single room for all living purposes is concerned, Mr. Ingersoll would have found, had he traveled elsewhere in Mexico, that living conditions for Mexican laborers in Pilares are infinitely better than in the majority of Mexican towns.

The company houses are substantially built. The roofs are tight, and the rent is less than the interest on the investment. Moreover, it is not true that the Moctezuma company does not attempt constantly to improve the living conditions of its Mexican employees. A few years before Mr. Ingersoll went to Pilares, the town was without any sewer system, like most Mexican towns. One was later installed at a great expense, all pipe trenches having to be blasted from solid rock. Drinking water was formerly mine water pumped back from Rosario. A pure water supply was developed six miles away and at a 1,400-ft. lower elevation. Pumps and pipe lines were installed and pure water was supplied to the town, because the company felt that it was essential to the health of its workers. The cost of this installation, as I remember it, involved an expenditure of around $100,000.

A plan was also developed to build model little homes and sell them to the Mexicans at cost. The great difficulty was to construct a home that would be within the means of the laborers. One was finally devised, using adobe walls and wooden roof construction which could be built for $500 gold, or 1,000 pesos. Many of them were built and sold to the company's employees on an easy-payment plan.

When I first went to Pilares, the common house flies existed there in dense swarms. They were spreading all kinds of disease among the people, and the mortality was especially high among the Mexican children. We imported a man with experience in sanitary work at the Panama Canal Zone, and in three weeks he had the town fly-less. Moreover, the sanitary squad which he built up was still functioning at last accounts. The town is cleaner than many American mining camps. A trip through the Slavonian and Polish quarters of nearly any of our Eastern coal fields and one through Pilares will show a tremendous contrast in favor of Pilares.

Mr. Ingersoll also leaves the impression, in the same chapter, that the Mexican miner is inefficient compared to the American miner, and I presume he refers to those at Bisbee. It might interest him to know that the stoping efficiency (that is, tons per man-shift) in cut and fill, square setting, and top slicing has been higher at times past in Pilares than at the Copper Queen, and I presume that this has continued. Also, the development footage per man-shift at Pilares has surpassed that at the Copper Queen, in Bisbee. The Mexican miner is highly efficient at Pilares, in the amount of work he does per man-shift, compared to the better paid American in the States.

What Mr. Ingersoll apparently fails to realize is that the Mexican in Pilares is living infinitely better and earning more money than he ever did before, especially if he came up from the south. Such wealth goes to his head, and as he is earning more than he needs to feed his family, he naturally spends it having a good time, and he does this by getting drunk. He is gradually improving his mode of living, and as he does so it costs him more money, so that eventually he will have considerably less surplus to spend for dissipation and alcohol.

Mr. Ingersoll takes a rap at the American colony at Pilares and its social life. He states the majority come from Main Street towns and pretend they are something which they are not. As far as I can make out from his book, these people are committing an offense against his good taste when the men take off their working clothes and put on a business suit, even if they expect a guest to dinner. Perhaps Mr. Ingersoll's idea of proper dress for an informal dinner in Mexico would be a khaki suit. Perhaps Mr. Ingersoll did not stay long enough in Pilares to discover that many of the American colony there are college men, and their wives equally well educated; that they come from all parts of the United States, even from New York City, and that they did not wear khaki at dinner in the U. S. A. and so are not putting on any airs when they put on a business suit in Mexico.

We engineers who have spent the greater part of our lives in mining camps, both big and small, and struggled with the daily problems of production, costs, and mill extractions, have had our noses so close to the grindstone that we have long since lost consciousness of the romance of mining. To such of us this book is especially welcome, as it brings back the underlying reason why we are miners. W. R. WADE.

Edwards, N. Y.

Tonopah Extension's Capacity

THE EDITOR:

Sir—In the article by Herman D. Budelman on the Tonopah, Nev., mining district, in your issue of July 5, 1924, an error was made as to the capacity of the Tonopah Extension mill. Over a year ago the capacity of the mill was increased to exceed 500 tons per day, and it has been treating an average of 457 tons daily for the last six months. With its sixty stamps, six tube mills, 15- to 85-ton agitators, and 267 Butters filters leaves, the plant is capable of handling 550 tons daily without decreased extraction and could treat 600 tons if crowded. EDSON S. PETTIS.

Tonopah, Nev.

Consultation

Biological Manufacture of Soluble Phosphate

"In an article appearing in the issue of March 8, 1924, written by the president of the Southern Gypsum Co., reference is made to 'new processes by which phosphate is made soluble without the use of sulphuric acid.'

"Do these processes referred to by the writer of the article utilize sulphur or gypsum . . . to cause partial solubilization of the phosphate by the oxidation of the sulphur by soil bacteria?"

The process mentioned is evidently the one that has been developed by Dr. J. G. Lipman and his staff, at the New Jersey Agricultural Station, for the production of soluble phosphates by biological means. Four parts of ground phosphate rock are mixed with one part of commercial flour sulphur. Cultures of sulphur-oxidizing bacteria are then added, and the mixture is kept at a suitable degree of moisture and temperature. The sulphur is gradually oxidized to sulphuric acid, and this acts on the phosphate rock, producing water-soluble or citrate-soluble phosphate. The practicability of the process is evidenced by the fact that superphosphate has been made by this method, giving results that equal those obtainable by the use of the commercial product.

Flotation Oils and References

"One of our engineers has asked me to try to get information with reference to the flotation method as used in the copper industry, especially as to the kinds and methods of using oils. It has occurred to me that your company could assist me in the matter by suggesting textbooks and publishing houses where these textbooks can be obtained."

In the flotation process, a minute quantity of an oil or other suitable reagent is added to a mixture of finely ground ore and water. The whole is then violently agitated with rapidly revolving paddles (in the "mechanical" process) or led through a trough through the porous bottom of which air is blown (in the "pneumatic" process), so that a thick froth is produced. The mineral content of the ore will largely be found in the bubbles of this froth, which are skimmed off, broken down with a fine spray of water, and the mineral recovered by settling and filtration. The oil and any other reagent that may be added performs two functions: it causes a proper froth to be formed, and it coats the mineral particles, causing them to attach themselves to the bubbles. Some oils do one of these things and some the other; also, some do both. Those which perform the first-named function are termed frothing oils; the others collecting oils. The most popular frothing oils are refined pine oils, and the most commonly used collecting oils are crude coal tar, the various creosotes, and fuel oils.

The oils used may also be classified according to their origin: (1) Petroleum oils, including petroleum residuum, fuel oil, crude kerosene, and sludge-acid kerosene. (2) Coal-tar products, such as crude coal tar, coal-tar oil, and coal-tar creosote. (3) Hardwood distillates. (4) Pine distillates, including both crude and refined steam and destructively distilled pine oils, pine tar, pine-tar oil, and crude turpentine. A newer class of reagents, which may be used either with or without those already mentioned, includes alpha-napthylamine, orthotoluidine, thiocarbanalide, and potassium xanthate. The ore pulp is also frequently made acid or alkaline to assist recovery of the mineral.

The latest important books on flotation include:

"The Flotation Process," second edition, 1918, by Megraw; McGraw-Hill Book Co., New York. "Concentration by Flotation," 1921, by Rickard; John Wiley & Sons, New York. "A Manual of Flotation Processes," 1921, by Taggart; John Wiley & Sons.

Market for Diatomaceous Earth

"Would it be possible for you to give me some information regarding the uses of diatomaceous earth? I have a large and very pure deposit of this mineral near a railroad and have been told that it is used by rubber, sugar and oil companies."

There is a large market for prepared diatomite products, but a very limited one for the raw material. It is used extensively for heat insulation, as an abrasive, rubber filler, filter aid, decolorizer, and for many other purposes; but the preparation of these products usually involves considerable expenditures for research and equipment. Moreover, the success of exploitation depends to a considerable extent on the availability of cheap transport to a point permitting shipment to the eastern states and abroad.

A large amount of specially prepared diatomite is being used in the refining of cane sugar and for a great number of industrial filtration processes; but buyers naturally insist on absolute uniformity as well as efficiency of the product, and this is only secured by technical control in manufacture on an elaborate and costly scale. It is probable that a limited local market could be developed for the crude material, for use as an insulator; or new applications might be devised to meet conditions and so insure profitable operation.

Permalloy

"Can you give me the name of the manufacturer or of a firm who can supply a special alloy known as permalloy? I believe this to be composed of 80 per cent nickel and 20 per cent iron; it is particularly used in the electrical industry on account of its high conductivity."

This is manufactured by the Western Electric Co., Hawthorne Works, Chicago. The composition is as you state, and a special heat treatment is used in the preparation. Dr. H. D. Arnold and G. W. Elmen, research engineers of New York, recently issued a report through the Engineering Foundation, in which they said that "the extraordinary magnetic permeability of permalloy means the ease with which magnetic lines of force penetrate it and make of it an electromagnet." Also, it is by far the most easily magnetized and demagnetized of all metals now known. It is said that its use in the manufacture of submarine cables will permit the transmission of messages at speeds far exceeding those now in practice.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

RECENT DEVELOPMENTS in the Tonopah "76" and West End Extension properties in Tonopah, Nev., forecast extended life for Nevada's foremost silver camp. The West End Consolidated Mining Co. is doing the work.

Belgian smelting companies have obtained another contract for zinc concentrate from the Joplin-Miami district.

Passing of its regular dividend by the Chief Consolidated Mining Co. is a temporary measure, pending the completion of the new mill.

F. W. Paine, speaking for Michigan copper-tariff advocates, looks for future rather than present benefit.

Increase in Porcupine's gold output results from Hollinger's milling 5,000 tons of $9 ore per day.

Use of surplus power generated by exhaust steam from its stamp mill will cut Quincy's copper mining costs.

A Federal appropriation of $100,000 for a new road in central Idaho should stimulate gold mining in that region.

Production of zinc concentrate in the Joplin-Miami district for the week ended July 19 was 11,786 tons.

The Ohio Copper Co. made 1,232,131 lb. of copper at a cost of 5.3143c. in June. Possibly a world's record.

If experiments being conducted at the Humboldt reduction works are successful, the United Verde Copper Co. will probably build a concentrator at Jerome, Ariz.

Production has been cut to one-quarter by the Cerro de Pasco Copper Co. in Peru.

Cerro de Pasco Copper Output Cut to One-fourth Capacity

Mystery in Action—Government Order Assigned as Reason—Condition of Mine May Be Factor

Because of the pressure of the Peruvian Government, the Cerro de Pasco Copper Co. has reduced its output of copper to 25 per cent of capacity, according to a statement issued by Charles D. Barney & Co., who have been connected with the company since its flotation on the New York Stock Exchange. Production has been at the rate of about 100,000,000 lb. annually since the completion of the new smelter, about twenty months ago, so that on this basis output now should be only 2,000,000 lb. monthly. It is possible that this figure will be exceeded by reason of the fact that the company is to be permitted to operate one reverberatory furnace, and that by the selection of richer ore more than one-fourth of the normal output may be realized. The entire equipment includes two reverberatories and two blast furnaces.

The reason assigned for the action on the part of the government is the claim that agricultural and grazing interests have been adversely affected by the smoke and fume from the smelter. The inference is that the curtailment will remain in effect until such time as equipment is installed for treating the smoke. As Cerro de Pasco has either bought all agricultural land within 18 miles of its smelter, or made satisfactory settlement with all agricultural interests within that distance; and as the Peruvian government derives large tax revenues from the operations of the company, which it would not willingly forego, the order seems strange.

In some quarters the opinion is expressed that the company has not opposed the order, and that the real reason for the curtailment is the present inability of the mine to produce more ore economically. It is said that only one reverberatory has been in operation for several months.

Porcupine Gold Output Increases; Hollinger Biggest Factor

Gross production of gold in the Porcupine district, in Ontario, continues to increase, due largely to the Hollinger, which is now treating approximately 5,000 tons a day of $9 ore. This is higher grade than for some time past.

During the six months ended June 30, the Dome mill treated 236,500 tons of ore, from which was recovered a total of $2,126,769, or an average of $8.89 a ton. Operating and general costs were $1,130,000, an average of $4.778 a ton; miscellaneous revenue was $113,368, and the net earnings, before depreciation, were $1,053,822, as against the company's dividend requirements of $953,344.

The McIntyre has declared the regular dividend of 5 per cent, payable Sept. 1 to shareholders of record Aug. 1. In June production at the Vipond amounted to $44,700, from 4,834 tons of ore, averaging $9.29 a ton; total costs for the month amounted to $34,000.

Granite Company's Cripple Creek Operations Expand

New Motor, Air Compressor, and Tram Will Be Installed—Open Dead Pine Shaft

Expanding operations of the Granite Gold Mining Co., at Cripple Creek, Colo., comprise the reopening of the Dead Pine shaft, where operations will begin upon the arrival of an 80-hp. motor, which has been ordered. A new twelve-drill compressor has been purchased, and with the compressor now installed, the Granite will have air capacity for twenty-two machines. An electric tram from the Dead Pine to the Dillon ore house will also be installed. The company operations on the Dead Pine for the present will be confined to the tenth level, from which a lateral will be driven north to open the orebodies on the Mohican claim, which are now being mined on the fourteenth and sixteenth levels from the Dillion shaft. Other levels of the Dead Pine will be leased, according to Henry Christensen, superintendent for the Granite company in the Cripple Creek district.

Leadore Revamps Mill

The Leadore Mining Co. operating in the Leadore district, in Montana, has just about completed the installation of flotation equipment and a set of rolls, and has made a few other changes in its mill. The new plant will be started in the near future.

Work has been started at the Trumbull property with a small crew of men.

New Road Expected to Stimulate Development in Idaho

"Central" Gold Belt Surveyed by State Mining Bureau Official—Declare Many Ore Deposits Warrant Deeper Exploration

The central Idaho gold fields, comprising the Buffalo Hump, Elk City, Orogrande, Florence Basin, and Pierce City districts, are likely to receive considerable attention in the near future from capital seeking gold properties. Interest has been stimulated by the announcement of the Forest Service that $100,000 will be appropriated to extend the highway from Grangeville to a point from which the different districts can be reached easily.

The field's development has been greatly retarded on account of extreme inaccessibility. The old roads blazed by the pioneer placer miners of the 60's are the only routes for entering the region.

A recent intensive survey of the districts has been completed by S. M. Ballard, of the Idaho Bureau of Mines. The results of the investigation are now being printed and will be incorporated in a report entitled "The Geology and Gold Resources of Central Idaho," comprising 125 pages of descriptive matter.

The dread spectre of superficial enrichment has probably done as much as lack of transportation in delaying development of the large number of veins showing attractive outcroppings of gold ore. Recent development has afforded the investigator opportunity to examine the ores microscopically, and conclusions have been reached which point to the probable continuance of certain types of veins to a depth of around 2,000 ft.

The report states further that forty veins visited, showing a width of from 2 to 40 ft. and followed along the strike from 600 to 6,000 ft., compare favorably as far as size and length are concerned with veins of Australia, California, and Cripple Creek. The report states that there are excellent reasons for believing that primary ore of workable grade persists in at least certain parts of the area to depths far below that of the present workings.

The district abounds in game and fish, and offers ideal opportunity to the prospector. The proposed road will make it easily accessible for the greater part of the year, as it will follow the water grade of the South Fork of the Clearwater, whereas now the only available roads cross summits of 7,000 ft. elevation, open only about three months of each year.

Talache Mill Heads at 28 Oz., Highest on Record

Operations of the Talache Mines, Inc., at Talache, Idaho, on the western shore of Lake Pend d'Oreille, are on a two-shift basis in the mill. The company is now concentrating the highest grade ore in its history. Mill heads in July have averaged between 28 and 29 oz. of silver and indications are favorable for the development of a high-grade oreshoot below the 1,200 level. A. H. Burroughs, Jr., is manager.

Prize of $125 for Some Ontario Prospector

THE Ontario Mining Association has decided to give a prize of $125 for the best report made by a prospector, for the disposal of a prospect which he has to sell. From the reports submitted it is proposed to compile a form, which the association will print for free distribution to the prospectors. It is hoped in this way not only to assist the prospectors but also to assist mining companies which are in the market for properties. G. C. Bateman is secretary of the association.

Childress Interests Purchase Wade Property in Joplin-Miami District

Frank Childress, of Joplin, Mo., with associates, has purchased the Wade Zinc Co.'s lease and mill, located in the western section of the Kansas portion of the Joplin-Miami district, for a consideration reported officially as "not less than $150,000," the greater part of which was paid in cash.

The new owners of the property have taken charge, with Earl Childress, of Baxter Springs, Kan., brother of Frank, as manager. Tom L. Wade had been principal owner of the property, which has been an excellent producer for some months. Operations are being conducted on the 260-ft. level.

The Childress family had disposed of the greater part of their holdings in this field with the sale of their properties to the Federal Mining & Smelting Co., recently. Besides the Wade, they have taken over the Fort Worth mine, in the Picher camp.

Montana Mines Produced $57,812,970 in 1923

According to the U. S. Geological Survey the value of the gold, silver, copper, lead and zinc recovered from ores mined in Montana during 1923 is estimated at $57.812,970, an increase of nearly $13,000,000 compared to 1922.

Silver Bow County, which means Butte, leads the twenty-two counties listed in production of all metals, having a record output of 5,261,344 short tons of ore that yielded metals valued at $54,495,627. The classified production is as follows: 30,359 oz. of gold; 11,837,475 oz. of silver; 223,043,071 lb. of copper; 25,501,740 lb. of lead, and 141,012,613 lb. of recoverable zinc.

Although only 382 mines were classed as producers in 1923, compared to 393 in 1922, the total and classified production for the various metals shows an average of more than 10 per cent increase in volume for 1923. Following is a summary:

Year	1923	1922
Number of producers	382	393
Ore treated, tons	5,743,535	4,385,878
Gold, oz.	85,079	80,145
Silver, oz.	13,380,862	12,468,151
Copper, lb.	224,125,264	165,754,442
Lead, lb.	35,945,623	29,767,479
Recoverable zinc, lb.	141,460,392	119,069,818
Total value	$57,812,970	$44,925,949

Chief "Con" Passes Dividend Pending Completion of Mill

Burdensome Smelter Contract Will Be Revised in 1925—Taxes Big Item in Expense—Outlook for Future Excellent

The Chief Consolidated mine, of Eureka, Utah, has passed the quarterly dividend of Aug. 1. This action has been taken owing to immediate heavy disbursements and pending the completion of the new mill, where much ore not now marketable will be treated. As stated by Walter Fitch, Sr., president of the company, "the accumulation at this time and in the near future of unusual and abnormally heavy payments, together with the severe drop in the usual income, the latter resulting from the smelting rates which under the changed conditions since the war have made the mining and treatment of certain classes of ore quite impossible, taken together, make the dividend payment decidedly inadvisable." The expected heavy payments are enumerated as follows: $466,000, assessed by the government, covering its claim for additional taxes for the year of 1916 and 1920; cost of the new mill approximately $450,000; Utah state and county taxes of over $100,000. To this is added the continuing cost of re-equipping and reopening of mines purchased in 1922—to date $380,000—totaling a sum that uses up not only the amount derived from the recent bond issue and the recent issue of treasury shares, but a large portion of the regular current reserve.

Reviewing the present condition of the property and looking to the future, it is shown that there is a marked improvement in production over the output of the last few months, owing to some rich ore coming in from two of the mines, which will more adequately produce after the revision of smelter rates in December, when substantial relief is promised. A saving in costs is expected from the application of the new concentrating process, which will make available heavier tonnages from the usual sources and from the newly acquired mines and from the Plutus mine, controlled by the company, and now a regular producer. For the future, there is expected the continuance of the same dividend regularity as that of the past, and the building up of a large cash reserve.

Lenora Shows 5 Per Cent Copper Ore

R. G. Mellin is developing the Lenora mine, at Mount Sicker, on Vancouver Island, under lease. He has uncovered an orebody 15 ft. wide, 95 ft. long, and 45 ft. deep carrying $1.50 gold, 1½ oz. silver, and 5 per cent copper. A bunker has been erected at the mine and another at Crofton, at tidewater. Mr. Mellin has the property under option and there is a possibility that the group of Tyee Mountain properties, which once produced substantially and profitably, will be consolidated under the control and management of a single company to permit their further exploration and development.

Brasch Brothers Find Arsenic in the Black Hills

Henry and William Brasch, of Deadwood, S. D., have uncovered a body of arsenopyrite ore on their mining property near Deadwood, on a branch of the Burlington railroad. The shaft is 55 ft. deep and a 24-ft. crosscut has been made at the bottom of it, without determining the width of the orebody. The analysis of the center 4-ft. vein shows an arsenic content of 19 per cent, and the rest of the ledge averages 5 to 10 per cent.

Years ago the Brasch brothers discovered arsenical ore in several places upon their property, but at that time arsenic was considered of little value. This arsenic bearing ledge can be traced for more than 3,500 ft., running northwest and southeast. The Brasch property comprises more than 500 acres of land adjacent to the Uncle Sam or Clover Leaf property, on which the Homestake Mining company recently secured an option. The Clover Leaf has been noted for its gold production.

Will Pump Out Old Carterville Properties in Missouri

Oklahoma City and Topeka interests have launched a project looking to the draining of a considerable area of mining land in the old Carterville, Mo., zinc field, belonging to the Connor Investment Co. Pumps have already been contracted for and it is expected draining operations will soon be started.

It is possible that draining at present will not be attempted to the level of the sheet ground mines formerly worked in this section of the field, but will be to a depth of about 120 ft., or a little deeper. This will permit the mining of several rich soft-ground deposits that have been located in the past few years, but the working of which has been impossible on account of the heavy water.

Other draining operations, of a modest nature, are already being carried on in this field by S. A. Betts and by the recently organized Teapot Dome Mining Co.

Gas Engines in New Skelton Power Plant

Work of rebuilding the power plant in the Joplin-Miami district of the Skelton Lead & Zinc Co., which was destroyed by fire a few weeks ago, is being pushed and will soon be completed.

Three new 200-hp. gas engines, with three new 1,200-ft. compressors are being installed, with three of the old 165-hp. gas engines and three of the 888-ft. air compressors, which were not totally destroyed by the fire.

Frank Childress, manager for the company, estimates the loss from the fire at about $100,000, only a part of which was covered by insurance. The power plant cost, new, about $175,000.

The enforced shutdown of the Skelton company has meant considerable curtailment for the district, as the company has produced about 500 tons of zinc ore per week for the last two years.

Great Significance Attaches to Recent Developments in Tonopah

Excellent Ore Opened by West End in Tonopah "76" Ground—Winze To Be Started from 800 Level—8 Ft. of $50 Ore—New Shaft Will Eliminate Long Haulage

RECENT developments in the western part of the Tonopah mining district add greatly to the probable life of the famous Nevada silver camp. Official confirmation has been made by the management of the West End Consolidated Mining Co. of reports of important developments in the Tonopah "76" and West End Extension territory. This territory is being developed by the West End under lease and agreement, and work is being carried on from the Ohio shaft 800 level. The "76 ' vein has consistently improved to the west and the drift on the 800 level has shown three oreshoots in the Tonopah "76" ground, all of commercial importance.

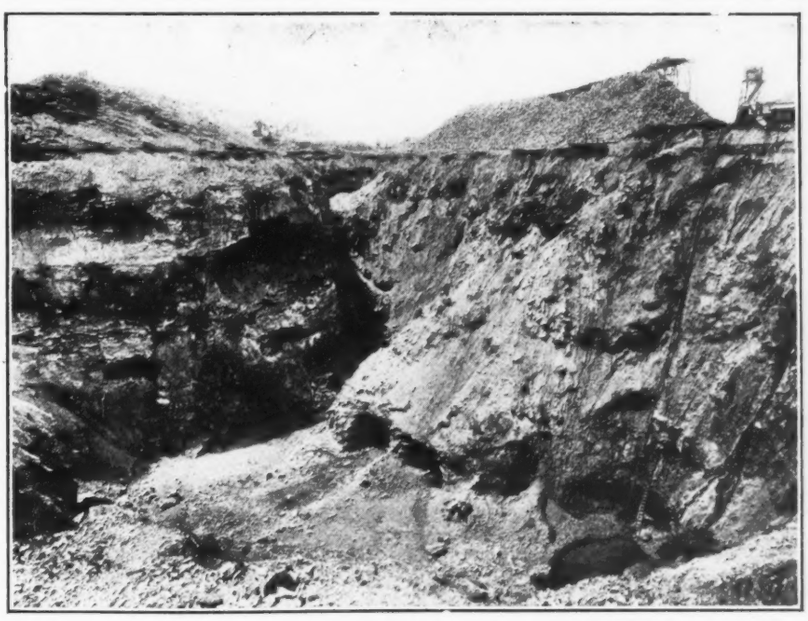
The drift is now in ore in West End Extension ground, and has been for the last 50 ft., the ore showing a minimum width of 8 ft. The face of the drift shows 8 ft. of ore which will average $50 per ton, and only one wall of the vein is exposed. Mill returns from the last two rounds, 15 tons per round, showed a value of $54 per ton. The ore is typical Tonopah ore, containing a complex mixture of silver sulphides in vein filling of quartz and rhodonite or rhodochrosite. Wall rocks have not been developed where the high-grade ore shows, but farther to the east the footwall rock was breccia and the hanging-wall rock West End rhyolite. This contact has been proven in the Tonopah Extension to contain large and rich bodies of ore.

A raise is up 100 ft. on the vein above the 800 level and a west drift has been started from the raise. This drift is in West End Extension ground and shows ore across the entire face. It is undoubtedly entering the same oreshoot that is being developed on the 800 level.

Preparations are now being made for the installation of an electric hoist, self-dumping skip, and underground bins for a winze to be started from the 800 level in Tonopah "76" ground. This winze will be started in about ten days, probably before the end of July, and will start in ore of better than milling grade.

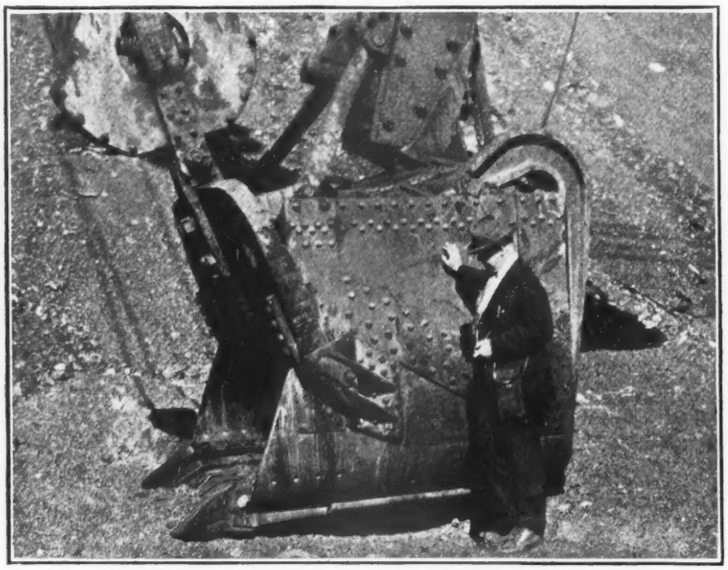
This is the most important recent development in the Tonopah district, and is in virgin territory. It is the most westerly ore in the district, and the fact that the vein is strong and rich, with consistent improvement to the west, opens possibilities for ground in the western part of the district which hitherto has been considered worthless, or which has been only partly developed. The ore as exposed is less than 600 ft. below the surface, with the upper limits not yet reached at any point, so that it is quite possible for the vein to extend upward for several hundred feet. There is no water to contend with, and very likely will not be any for at least 600 ft. below the 800 level.

As soon as developments indicate proper location a new shaft is to be started by the West End, from which future western development will be carried on. At the present time all muck has to be hauled for a distance of one mile to the nearest shaft, storage-battery locomotives being used for the purpose.



In the Carterville section of the Joplin-Miami field

The Orange mine is one of the properties that produced profitably in this section of the zinc-lead region



Business end of a steam shovel. C. C. Brayton is looking at the manganese steel teeth of this shovel in the United Verde mine

Resume Work in Newhouse Tunnel, at Idaho Springs

The Newhouse, or Argo, tunnel and mill at Idaho Springs, Colo., has been taken over under a lease and option by St. Louis interests, and will at once be put in condition for operation under charge of S. G. Hamlin, who says that it is the intention of the company to put the tunnel and mill in first-class condition as soon as possible. The mill will be overhauled and remodeled. The company will operate the old Gunnell property, and it is expected that several other properties along the line of the five-mile tunnel will resume operations.

Tonopah Extension Will Sink to 2,250 Ft. on Murray Vein

The Cash Boy shaft of the Tonopah Extension Mining Co. has entered the hanging wall of the Murray vein at a depth of 2,160 ft., and shows 3 ft. of ore which essays $20 to $30 per ton, with no footwall exposed. The vein has steepened to a dip of 75 deg. The next level is to be established at the 2,250-ft. point and the actual width of the vein will be determined on this level. If the ore continues as wide and as rich on this level as on the 2,000, which is at present the deepest working level, and on which level the vein ore reaches a maximum width of 110 ft., an enormous addition to ore reserves will be made.

Nevada Rand Continues Shipments

The latest shipment of ore made by the Nevada Rand Mines Co., from its property in Mineral County, Nev., shows the following returns: 1.17 oz. gold; 67.50 oz. silver; value $68.71.

W. V. Rudderow, manager, states that the ore comes from the raise now 30 ft. above the 250 level, where recently a body of high grade was disclosed in regular development work.

United Verde May Build Concentrator at Jerome

THE United Verde Copper Co., of Jerome, Ariz., is conducting a test on milling siliceous ores at the mill of the Southwest Metals Co. at Humboldt, under a rental agreement that has been made with that company. The Humboldt mill has been closed since last October and has just now been reopened for the United Verde ore with a small crew, but later it is expected that three full shifts will be put on. About 100,000 tons of the ore will be milled, and, if successful, it is likely that the United Verde will construct a mill at its Jerome plant. All of the ore at the United Verde has been of such grade and character that it has been heretofore smelted direct, but it is thought that milling of the ores containing high percentages of insolubles will be more profitable.

Stir in Mining Activity in Southwestern Oregon

Development work at the Millionaire mine, in the Gold Hill district of southwestern Oregon, totaled 600 ft. of crosscutting and drifting in 1923. The working shaft was sunk to the 300 level, and 100 ft. of drift finished on the level. Since Jan. 1, 1924, connections are in progress between the 200 and 300 levels. It is hoped to be able to sink the shaft to 1,000 ft. and to install a 200-ton mill. Some good ore has been developed.

A sampling and ore-testing plant is being installed by H. M. Lancaster at Grants Pass. Work has been started on a 100-ton Mace smelter at Gold Hill. A custom five-stamp mill is being erected at Rogue River.

Isle Royale Making 700,000 Lb. of Copper per Month

Costs 12½c. Before Depreciation—Development Good—About 50 per Cent Capacity Operation.

Isle Royale, in the Michigan copper district, is again using its stamp mill after a ten-day shutdown to permit of boiler-house repairs. There was no loss in production, however, rock being treated in the Ahmeek mill during that period. Isle Royale output is at the rate of about 700,000 lb. of refined copper per month. A total force of 375 men is employed. Isle Royale could probably double production if it were desirable. Four shafts remain idle, Nos. 4 and 5 being in operation.

The property is a notable example of what has been accomplished in Lake mines in effecting lower costs through efficient methods and close rock selection. The present cost of 12½c. per lb., before depletion and depreciation, is equivalent to 8c. on the basis of prewar cost of labor, coal, and supplies.

Since 1913, labor cost has increased 2c. per lb. of copper; coal, 1c.; and powder, timber, steel pipe, and other supplies, 1½c. The property is well opened, having large reserves of stoping ground, and the present yield of close to 26 lb. per ton no doubt can be maintained as long as necessary. No. 5 shaft is particularly rich, 90 per cent of the ground opened having good values. The greater part of the vein opened in No. 4 shaft is of similar character. All of the shafts in the property are comparatively shallow for Lake shafts.

The shift goes down at the Homestake in South Dakota

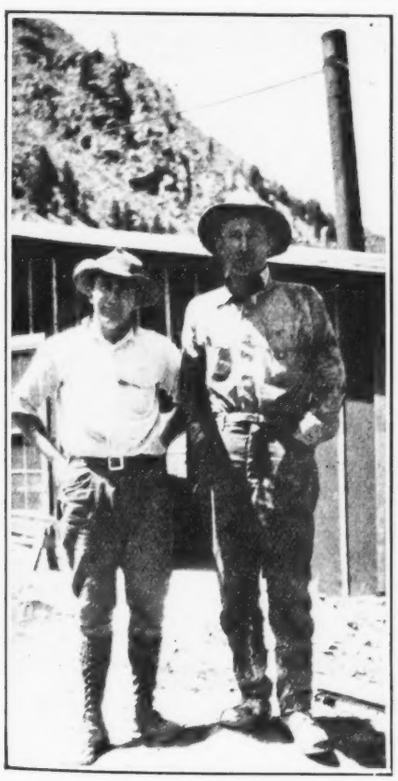
Belleview-Hudson Ships From New Mill at Idaho Springs

Concentrator Erected at Small Cost—A. Hanson Built Plant and Now Runs It—Silver-lead Ore

The principle of minimizing capital and overhead costs was the guiding purpose of A. Hanson when he started last fall to build the 50-ton concentrator of the Belleview-Hudson Milling Co. a few miles above Idaho Springs, in Clear Creek County, Colo. The company has recently started shipping lead-silver concentrate running about $100 per ton, with a zinc content only a little above the 10 per cent free limit. The zinc carries silver, and so no effort at preferential flotation is made. The mill feed thus far has come from the old dumps and has averaged around $8 per ton in lead and silver; but underground mining operations through the old tunnel are ready to begin.

More than one company with a proposition similar to this has hired a big staff of engineers or near-engineers, managers, auditors, superintendents, metallurgists, and mill designers, and assistants for all these, and has spent $200,000 or more getting ready to start production. Mr. Hanson holds all these positions himself; in addition he was chief millwright and foreman of the concrete gang during the construction period and he is now mill foreman.

The framework for the mill structure is made largely of raw round timber, cut on the property. The necessary sawed stuff and the tarred paper with which the plant is covered was obtained from abandoned mill buildings in the neighborhood, and at small cost. The machinery and mechanical equipment are part second-hand and part new, but everything is in good operating condition. The equipment includes crusher and rolls made by the Denver Engineering Works and a ball mill supplied by the Colorado Iron Works. Jigs, K. K. flotation machines, and two Wilfley tables comprise the concentrating machinery proper. The cost of the entire plant ready to operate did not exceed $25,000.



A. Hanson, on the right, is "boss" around the Belleview-Hudson

Flotation plant of the Belleview-Hudson Milling Co. at Idaho Springs, Colo.

The ore from the ball mill, without classification, is floated. One of the tables handles the flotation tailing to catch any coarse concentrate that may escape the machine, and the other serves to clean the flotation concentrate, the tailing being returned to the circuit. After drying on steam coils, all the concentrate products are mixed for shipment. The jig concentrate, rich in galena, and representing half the recovery, serves to reduce the average zinc tenor of the shipping product.

The accompanying illustrations show the outside of the mill building, and two-thirds of the mill crew. The man on the right is Mr. Hanson.

Crown Reserve Wants $350,000 to Build Mill in Ontario

The Crown Reserve is offering to its shareholders 1,000,000 shares of treasury stock at 60c. a share, payable 20c. on subscription, 20c. on Aug. 30 and 20c. on Sept. 30.

The company now has 1,392,043 shares in the treasury. The money will be used to carry on development work, supply a new plant and equipment, build a 250-ton mill unit, and provide working capital.

The engineer's report shows that above the 500 level there has been developed 128,000 tons of ore of a gross value of $890,000, or an average of $6.95 a ton. Though this is lower than the average grade of ore treated by the gold mines of northern Ontario, it is estimated that a profit can be made when working on a 250-ton basis. The mill is expected to cost $250,000, and with the necessary addition to the plant and additional development required, $350,000 will be needed. The balance will be used for working capital and to provide mill additions as required.

Quincy Will Save by Use of Surplus Power

New Transmission Line Just Completed—Use Exhaust Steam From Stamps to Run Generators

An 11,000-volt transmission line has been built by the Quincy Mining Co. between its stamp mill and mine, in the Michigan copper district. It will furnish all electric power at the mine. This will effect a large saving for it will utilize excess power developed from exhaust steam from the stamps by the turbo-generator at the mill. Mill and mine are working at about half capacity and present excess power is adequate for the mine's needs. The generator's capacity is sufficient to meet all requirements in power at both mill and mine when both are working full force. Power from the mill will be used to operate underground locomotives, machinery in all of the shops, and for lighting purposes, both on surface and underground.

Quincy is equipped with twenty-five electric locomotives, but only little more than half of these are in operation on the present basis. The transmission line is 6½ miles long, and is a substantial, permanent installation. At present capacity, the cost of installation will be saved in from six to nine months.

The turbo-generator at the mill supplies power for the regrinders, ball mills, pumps, sand pumps, and all other mill machinery aside from the stamp heads, as well as current for the lighting of the mill and vicinity. The economy of this plant is shown in the consumption of 640 fewer tons of coal in a single month's operation, the mill stamping as much rock as went through before the installation of the generator, and furnishing as much electric power as was previously consumed in a month. Quincy's production in refined copper is at the rate of approximately 1,100,000 lb. per month.

Experienced labor is more plentiful than in the spring months, and Quincy is having no trouble in maintaining an adequate underground balance in accordance with present needs. Physically, the mine was never better. Values at depth are even better than in the upper levels.

Joplin-Miami Zinc Production Over 11,000 Tons Weekly

Small Producers Seem Disinclined To Curtail—Production Exceeds Current Sales of Concentrate

Despite efforts on the part of some producers to obtain concerted action toward curtailment of production, the output of zinc concentrate in the Joplin-Miami field remains higher than the current rate of sales. The following tables show the active operators and their output for the week ended July 19, together with the figures for the year to date. Production figures are given in pounds:

Oklahoma

Company	Zinc	Lead
Admiralty Zinc Co.	680,230	.....
Acme M. Co.	429,600	34,000
Amalgamated M. Co.	167,850	.....
Anna Beaver M. Co.	.....	281,080
Baby Jim M. Co.	86,380	.....
Commonwealth M. Co.	253,030	65,480
Crystal M. Co.	172,840	.....
Cortez M. Co.	51,140	96,500
Dorothy Bill M. Co.	367,830	128,000
Edgar M. Co.	90,230	.....
Eagle-Picher Lead Co.	1,515,610	64,380
Federal M. Co.	86,340	.....
Federal Dobson	540,370	.....
Federal Gordon	1,035,540	.....
Federal Lucky Syndicate	.....	88,320
Federal Lucky Bill	89,670	.....
Federal Whisk Broom	361,760	.....
Golden Rod M. and S. Co.	2,561,310	165,010
Grace B. M. Co.	119,320	.....
Goodeagle M. Co.	223,360	170,980
High Tail M. Co.	89,170	.....
H. & M. M. Co.	164,610	.....
H. K. M. Co.	.....	4,930
Indiana M. Co.	317,620	.....
Jeff City M. Co.	53,850	.....
Laclede L. and Z. Co.	86,610	.....
La Salle M. Co.	85,260	.....
Lion M. Co.	520,910	.....
Lucky Kid M. Co.	345,790	.....
Mahutska M. Co.	171,470	.....
Neal & Robinson	77,320	.....
New Chicago M. Co.	84,860	.....
New York M. Co.	471,610	.....
Oko M. Co.	204,110	.....
Pat M. Co.	129,470	.....
Quapaw Tom L.	186,100	90,310
Rialto M. Co.	254,520	.....
Santa Fe M. Co.	317,780	.....
St. Louis S. and R. Co.	2,477,420	254,360
Skelton L. and Z. Co.	187,420	199,350
S., R. & W. M. Co.	171,860	64,000
S., L. & G. M. Co.	133,350	.....
United Zinc Manhattan	258,470	.....
Underwriters Land Co.	1,141,440	.....
Vantage M. Co.	.....	85,000
Vinegar Hill Wilson	92,500	.....
West Virginia M. Co.	128,140	.....
Sundries	249,110	536,600
Totals	16,423,000	2,338,300

Kansas

Company	Zinc	Lead
Big Elk M. Co.	88,570	.....
Baxter M. Co.	64,110	.....
Blue Diamond M. Co.	85,540	.....
Chanute Spelter Co.	724,000	.....
Cherokee L. and Z. Co.	177,600	.....
Empire Dev. Co.	236,010	.....
Eagle-Picher Bendelari	181,910	.....
Eagle-Picher Tom Brown	130,210	.....
Eagle-Picher Lucky Jew	84,290	.....
Federal Kansouri	222,750	.....
Federal Muncie	632,690	.....
King Brand M. Co.	228,360	.....
Lawyers M. Co.	790,830	.....
Queen Esther M. Co.	151,570	.....
Quapaw Chubb	151,250	93,220
Racetrack M. Co.	215,770	.....
Redskin M. Co.	269,480	.....
Southern L. and Z. Co.	498,880	.....
Tulsa-Quapaw M. Co.	65,130	.....
Vinegar Hill Barr	86,060	.....
Wade M. Co.	523,110	.....
Totals	5,608,130	93,220

Missouri

Amer. Z. L. and S. Co.	285,300	.....
Barnsdall Zinc Corp'n.	668,500	.....
Butte-Kansas M. Co.	444,930	.....
Freehold O. and G. Co.	82,660	.....
Tulsa-Pittsburg M. Co.	87,730	.....
Total	1,542,120	.....

Summary

Production for the week ended July 19: Zinc 23,572,250 lb., value $459,754; lead 2,431,520 lb., value $97,200; total value for week, $556,954.

Year to date, twenty-eight weeks: Zinc 765,759,870 lb., value $15,681,306; lead 99,770,520 lb., value $5,068,607; total value, $20,759,913.

John Taylor & Sons Will Drill Rouyn Prospect

Arthur D. Miles, representing the English mining firm of John Taylor & Sons, has acquired from Gideon Miller, Wilfred J. Grace, and David Thompson the Metcalfe-Grace group of claims south of Pelletier Lake, in the Rouyn gold field. Engineers have made favorable reports, and attractive gold showings occur on the property. A large cash payment is to be made on Sept. 1 and sufficient capital has been provided for diamond drilling and extensive development. Preliminary plans call for the erection of a 100-ton mill if present indications are borne out by results.

Gold Leaf Beaters Want Tariff

In response to a petition from the gold leaf beaters and from the Association of Gold Leaf Manufacturers for an increase in the duty on gold leaf, the U. S. Tariff Commission is making an exhaustive investigation of the domestic industry, which produces gold leaf to the amount of $3,000,000 annually. The field examination is under the direction of Myron R. Walker, the commission's engineer on non-ferrous metals. The field work has covered the establishments in Pennsylvania, New Jersey, New York, and in a part of New England. That territory comprises the principal producing districts, although Illinois and California contribute importantly to the country's total production.

The gold leaf industry is carried on in over 100 plants, employing more than 1,000 persons. Germany is the chief competitor. Practically no gold leaf is exported from the United States, but during the calendar year of 1923 imports amounted to 10 per cent of the domestic production. The industry until recent years has been carried on almost exclusively by families in which the trade passed from father to son, but now shows a decided trend toward integration in large plants. Nearly half of the gold leaf produced in the United States is used for book bindings, for titles, and for gilting edges. Lettering on glass and on other materials is an important use.

Copper Tariff Advocates Look for Future Benefits

A TARIFF is being sought by the copper producers of Michigan, according to F. W. Paine, prominently identified with the domestic industry in Michigan and Montana, not with any thought that it will be of benefit under present conditions, but with the idea of having it on the statute books when the rapidly mounting curve of domestic consumption overtakes the curve of American production.

Mr. Paine has been in Washington in conference with members of the Tariff Commission, with regard to the resolution of Representative James, of Michigan, which proposes the imposition of an import duty of 6c. per pound on copper. Mr. Paine contends that 60 per cent of the copper produced in the United States is marketed at a loss. He attributes the low price of the metal to competition now presented by Africa and South America. That copper, he told the Tariff Commission, entering the United States free of duty and competing directly with higher-cost domestic copper, has lowered the price to the point where it is not, for the time being, profitable for the copper mines of Michigan and of Montana to operate.

Furnace Patentee Wants Share of Anaconda's Profits

George Campbell Carlson, of San Francisco, filed suit in the federal district court on July 15 against the Anaconda Copper Mining Co. for alleged infringement of letters patent. Mr. Carlson alleges that the mining company has infringed on certain patented inventions of his that are used in the construction of open-hearth and reverberatory furnaces. The plaintiff demands a share of the profits made by the company during the period the patents are alleged to have been used. A large sum is involved in the claims as set forth.

World's Record for Low-Cost Copper Production—5.3143c. by Ohio Copper Co.

THE Ohio Copper Co., of Bingham, Utah, shows net operating profits of $85,001 for June, 1924. Net production was 1,232,131 lb. copper, which brought $149,950. The per pound cost—the lowest since the starting of leaching-in-place operations—was 5.3143c., and this figure probably breaks the world's record for low cost of copper production. For the first months of 1923, the monthly production averaged 966,000 lb., and for the current half of the year production is expected to average well over a million pounds monthly.

During the period there were shipped to the smelters 8,755,280 lb. of wet precipitates, which, after deducting 2,354,805 for moisture (the average moisture content having been 26.89 per cent), left 6,400,475 dry pounds. The average copper content was 90.58 per cent, and the gross copper shipped was 5,797,526 lb. Copper deduction made by the smelter was 210,235 lb., leaving 5,587,291 net pounds paid for by the smelter. From this there was realized $709,275. The average price paid by the smelter was 12.6914c. per lb. Total cost per pound, including smelter charge, was 5.715c. per lb. Operating profit per pound was 6.9794c. and the total operating profit was $389,968 for the period.

Belgian Smelters Get Another Contract for Joplin-Miami Zinc Concentrate

ANOTHER contract for a shipment to Antwerp, Belgium, of zinc ores from the Joplin-Miami district was made by the Golden Rod Mining & Smelting Co. on July 25. This is the second contract of the sort, the ore for the first consignment being shipped some days ago. It is announced that the second order, which, though small, is considered encouraging as evidencing a probable future use of this district's ore by Belgian smelters, did not come from the same firm that gave the first order.

Dross, Containing 66 Per Cent Aluminum, Duty Free

The Treasury Department has ruled that aluminum waste, or dross, is entitled to enter the United States free of duty under paragraph 1,562 of the tariff act as a crude mineral substance. The ruling arose through a variance in practice between customs officials at Buffalo and at New York. The appraiser at Buffalo held aluminum waste to be entitled to entry free of duty. The appraiser at New York, on the other hand, made an advisory return on an importation as dutiable at 10 per cent ad valorem under paragraph 1,457 of the tariff act covering waste of all kinds not specially provided for by the law.

Analysis of a sample of the aluminum waste scrap made for the Treasury Department showed it contained 66 per cent of aluminum and the department ruled that it was entitled to entry free of duty, in accord with the ruling made at Buffalo under the classification "crude mineral substance."

Falcon Mines Produced £24,184 in June

Advices by cable from Bulawayo, Rhodesia, state that the Falcon Mines, Ltd., crushed 16,752 tons of ore, producing 234,230 tons of blister copper, containing 2,274 oz. of gold and 4,884 oz. of silver during June, 1924. The estimated value is £24,184, taking copper at £56 per ton, gold at 94s. per ounce, and silver at 2s. 6d. per ounce.

Chinese Eastern Railway Wants Silver for Freight Payments

The continued decline in the exchange value of the yen has caused the directors of the Chinese Eastern Railway to issue an order providing that all payments to the railway be made in silver dollars, according to advices received from G. C. Hanson, American Consul at Harbin, by the U. S. Department of Commerce. Prior to the issuance of this order payments by shippers and other lines might be made either in yen or silver dollars, and agreements to this effect had been made with the South Manchurian and Ussuri Railways. The recent steady decline in the exchange value of the yen has resulted in all payments being made in this currency, with the result that the company has been losing large sums on exchange, as most of its disbursements are in silver dollars.

Serious protests have been made by the South Manchurian and Ussuri Railways on the ground that the new order violates long-standing agreements and upsets existing rates. Exporters are also much concerned, since all their transactions have been made on the basis of the old arrangement and the sudden change entails serious loss. In consideration of these protests the directors of the company have decided to postpone for a short period the putting into effect of the new order.

Great Expansion Planned for Trail Reduction Works in British Columbia

THE Consolidated Mining & Smelting Co. of Canada has improvements under way at its Trail smelter which are expected to keep the company's construction department busy until the end of next year. These include additions to the lead refinery which will bring the capacity of the plant up to more than 300 tons of refined lead per day from the present capacity of 178 tons; additions to the zinc plant that will give it a capacity of close to 200 tons per day; enlargement of the silver refinery and the addition of a plant for working up antimonal residues into merchantable metal; a new drossing and lead anode-casting plant; a new stack that will be higher than any of the existing stacks and will have sufficient natural draft to avoid the necessity of fans; four new Cottrell fume-treaters; one Dwight-Lloyd roaster for the zinc plant and three Dwight-Lloyd sintering furnaces for the lead plant; a new boiler house and several additions to the foundries and machine shops, to enable all kinds of metal work to be done by the company's own employees.

This program is expected to be finished by the end of next year, and the larger proportion of it will be paid for out of earnings. It is expected that the West Kootenay Power & Light Co.'s new No. 2 plant at Bonnington Falls, now under construction, will be ready to supply all the power needed at the smelter by the time that the foregoing improvements have been completed. In the meantime the Consolidated company will continue to ship to Europe, for treatment, the zinc concentrate, base bullion, and copper matte that cannot be handled at Trail.

London Letter

By W. A. Doman
Special Correspondent

New Gold Reef Found in India, According to Reports

John Taylor & Sons London Office Knows Nothing of It—May Be Reopening of Old Property

London, July 14, 1924—Much interest was created during the latter part of last week by a cable dispatch from Allahabad, India, to the effect that a new gold reef had been discovered 8 miles south of the Mysore mine, at Kamasamudram, where prospecting is still being done. As the Kolar field is under the control of John Taylor & Sons, it was assumed that the firm would naturally have definite information concerning the reported find. On application it was said that the rumor had reached them, but that they knew nothing official. It is now generally assumed that the reef is one formerly worked by a company which years ago bore the name of Mysore Reefs Kangundy. A good deal of development was done in this property and gold was found in the reef, but not in commercially profitable amounts, and eventually the mine was abandoned. As, however, certain parts of India seem to abound in old workings, and as prospectors are always keen on investigating abandoned properties, there is just the possibility that a reef with satisfactory gold content may have been discovered. Until further information comes to hand, little importance will be attached to the rumor.

The East Rand Proprietary Mines controversy is becoming rather more interesting. None apparently knows the exact position of affairs, either at the mine or in the share market on this side, but the rumors that I have mentioned on a previous occasion still hold good. I understand that L. E. B. Homan, who represents Sir Abe Bailey, is endeavoring on behalf of the Witwatersrand Deep to obtain control of the East Rand Proprietary Mines. The Wit. Deep itself would scarcely have the money to buy full control, for, naturally, in the event of a fight, the shares rise and the price to be paid increases, so that it cannot be the Wit. Deep itself. Sir Abe Bailey is now on the way home, and the matter may be solved at an early date. With reference to the developments on which the buying was started, it is said that a patch of high-grade ore has been, or is being, opened up in the lower levels of the Driefontein Section. In this connection there seems to be a leakage of information. The London officials are credited with knowing nothing; at least no specific information has been given beyond that referring to one point on the 33d level, and this could not possibly make the mine a payable property. On the other hand, those in close touch with the mine say they have definite information that it is opening up well, and that judging by present appearances the whole character of the undertaking has been changed.

Societies, Addresses, and Reports

Gold-Silver Inquiry Prints Revised Edition of "Dope" Book

New Charts, New Reports, and Dawes Plan Get Attention—Ready for Salt Lake Conference

The Senate Commission of Gold and Silver Inquiry has revised and enlarged its serial dealing with gold and silver statistics. The printing of the new edition has been rushed through the Government Printing Office so as to be available for use at the meeting in Salt Lake City.

All tables have been brought up to date, and ten new charts, showing price curves covering gold and silver as compared with foods, clothing, building material, fuel and light, chemicals, house furnishing goods, and other products, have been added. The new edition also contains an analysis of the production of gold and silver in the United States during 1923 by H. N. Lawrie, the commission's economist. It contains a progress report from the Bureau of Mines on its work looking to the development of new industrial uses for silver.

The new volume, which contains 291 pages, presents the entire text of the important paper read June 11 by Prof. Gustav Cassel before the London meeting of the Institute of Bankers. An analysis of the Dawes plan by Fred I. Kent, of the American Bankers' Association, is published as well as the commission's correspondence with the Dawes committee. There is exhaustive treatment of new coinages and other recent material.

The index numbers of wholesale prices since 1890, which appeared in the earlier edition, has been revised in the important particular of including the index number for silver.

An important feature of the edition is the presentation of the commodity charts. It has required work night and day by the commission's staff, and the hearty co-operation of the Government Printing Office, to get this material into the book, as none of the fiscal year figures were available until after July 10, and many of them were obtainable only at later dates.

Ceramic Society to Meet in October

The date for the summer meeting of the American Ceramic Society has been set for Oct. 6 and 7, at the Hotel Biltmore, Los Angeles, Calif. Morning and afternoon sessions will be devoted to the reading of papers and discussions. Railroad excursion rates will be granted with the usual stop-over privileges at points en route.

Information can be obtained from Fred B. Ortman, chairman of the summer meeting, Tropico Potteries, Inc., Glendale, Calif., or from the general secretary of the society, at Lord Hall, Ohio State University, Columbus, Ohio.

Tentative Program Announced by Mining Congress

Varied Interests of Metal-mining Industries Will Be Discussed by Delegates at Sacramento

The first session of the American Mining Congress, which is to be held at Sacramento, Calif., during the week of Sept. 29 next, is set for Monday afternoon, Sept. 29. It will be the annual taxation and standardization conference. The formal welcome that evening, according to the tentative program, includes an outdoor reception to the delegates, with an address of welcome by the Governor of California, the Mayor of Sacramento, and a representative of the Sacramento Chamber of Commerce.

President H. W. Seaman will deliver his annual address at the Tuesday morning session, which is to consist of a general symposium on the condition of the industry in the various states. F. E. Sheppard, director of the United States Mint at Denver, also is down for an address, and the review of the operations in the last year will be offered in five-minute speeches by the following: William J. Loring for California; Robert E. Tally for Arizona; Jesse McDonald for Colorado; Stanly Easton for Idaho; L. S. Cates for Utah; S. Pemberton Hutchinson for the bituminous coal industry; and E. W. Parker for the anthracite industry. Other speakers will be named later.

Federal and state taxation of mines is the topic for the Tuesday afternoon session. Secretary of Labor James J. Davis has been invited to make the principal address at the Tuesday evening session, when industrial co-operation will be taken up. L. S. Cates, of the Utah Copper Co., also will speak.

Wednesday, which will be a half-day session because of the afternoon and evening entertainment features, will be devoted to a wide range of topics.

The gold producers will discuss their troubles and suggested remedies at Thursday morning's gathering. Group conferences on the tariff, standardization, freight rates, oil shale, and other matters of special interest will start Thursday afternoon, to be continued through Friday. Thursday evening's session is to be devoted to consideration of financing mining enterprises.

The silver producers will be heard on Friday morning. The men who will represent this branch of the industry in leading the discussions will be W. Mont Ferry, Salt Lake City; J. G. Kirchen, Tonopah, Nev.; Alfred Harrell, California; and C. F. Kelly, of New York City.

The annual banquet is set for Friday evening at Sacramento's new Hotel Senator. Secretary of Commerce Herbert Hoover has been invited to make the leading address. The program also includes a speech on the development of the steel industry on the Pacific Coast by a speaker yet to be named; and an address by Paul Shoup, vice-president of the U. S. Chamber of Commerce.

Franklin Institute Centenary at Philadelphia in Fall

A Long List of Interesting Addresses Announced in Preliminary Program of Meeting

The centenary celebration of the founding of the Franklin Institute and the inauguration exercises of the Bartol Research Foundation will take place in Philadelphia on Sept. 17-19, next. A preliminary program has recently been issued. Delegates and guests will assemble at the hall of the Franklin Institute on the morning of Sept. 17. From here the academic procession will take place to the Walnut St. Theater, where addresses of welcome will be delivered by the Mayor, by W. C. Eglin, president of the Institute, and by Elihu Thomson, honorary chairman of the Celebration Committee. During the three-day period, meetings will be held at the hall of the Franklin Institute and at other appointed places. On Friday a tablet will be unveiled at the Bartol Research Foundation.

Many notable addresses are included in the preliminary program. On Thursday Sir Ernest Rutherford will talk on "The Natural and Artificial Disintegration of Elements." Prof. G. S. Jacobus will speak on "Stimulation of Research and Invention." Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution, Washington, will have for his subject "Some Causes of Volcanic Activity." Prof. P. W. Bridgman, of Harvard, will talk on "Some Aspects of High Pressure Research," and Prof. Wilder D. Bancroft, of Cornell, will discuss "The Development of Colloid Chemistry."

"The Mercury Boiler" will be the subject of W. L. Emmet, of the General Electric Co. Prof. F. Haber, of Berlin, will deliver an address on "Technical Results of the Theoretical Development of Chemistry." Others of the speakers and their subjects are as follows:

Irving Langmuir, of the General Electric Co.: "Electric Discharges in Gases at Low Pressures."

Prof. C. H. Mathewson, of Yale: "The Trend in Physical Metallurgy."

Prof. W. Lash Miller, of the University of Toronto: "Concentration and Polarization of the Cathode During Electrolysis of Solutions of Copper Salts."

Charles L. Reese, of E. I. du Pont de Nemours & Co.: "Twenty-five Years' Progress in Explosives."

Prof. Bradley Stoughton, Lehigh University: "Magnetic Analysis of Steel."

E. W. Rice, Jr., General Electric Co., Schenectady, "The Field of Research in Industrial Institutions."

Ontario Mining Association Elects Officers

At the annual meeting of the Ontario Mining Association which was held at Georgian Bay, Ontario, July 18-20, J. L. Agnew, president of the International Nickel Co. of Canada, was elected president of the association, A. F. Brigham, of the Hollinger Consolidated, and J. P. Watson, of the Mining Corporation of Canada, were elected vice-presidents, and G. C. Bateman was elected secretary-treasurer.

Men You Should Know About

B. Dunstan, Chief Government Geologist, Queensland, Australia, has been twenty-seven years on the Queensland staff, and for twenty-two years its head. Mr. Dunstan is a native of one of the other Australian states (Victoria), having been born in Castlemaine in 1864. He is a Fellow of the

B. Dunstan

Sydney (New South Wales) Technical College, and was there a lecturer in geology, mining, and metallurgy for six years. In 1897 he was appointed assistant government geologist on the Queensland Geological Survey, when the late Dr. Jack left that staff to go on a special mission to China. Mr. Dunstan in 1902 was promoted to the position of acting chief of the Survey, and in 1907 was given the full title and status of Chief Government Geologist, which position he still holds. Besides being an all-round geologist of high attainments, Mr. Dunstan is an authority on precious stones, in which he takes a keen interest, and is the author of the "Queensland Mineral Index and Guide," a work of some thousand pages, besides sixty colored plates and maps. The preparation of this book involved arduous labor extending over several years, and the result is a comprehensive work of reference of great value alike to the scientist, the prospector, and indeed to all who take an interest in the mineral wealth of the vast Australian Commonwealth and of Queensland.

A. H. Brooks, geologist, is en route to Alaska.

Howard Willey, mining engineer, who has been with the Cerro de Pasco Copper Co., in Peru, for two years, returned to the United States on July 28.

Premier John Bracken, of Manitoba, has returned to Winnipeg from a visit to The Pas mining region and reports a healthy development in progress at Elbow Lake and Herb Lake, the properties that are being worked showing excellent results. A good deal of capital is coming in from Great Britain.

Josiah Edward Spurr, Editor in Chief of the *Mining Journal-Press,* has been reappointed as a member of the Advisory Committee of the Natural Resources Production Department of the Chamber of Commerce of the United States of America. The other members of the committee, as proposed, are: **Milton E. Marcuse,** chairman; **Hugh P. Baker, R. V. Norris, Sidney J. Jennings, Van. H. Manning, H. I. Harriman, J. G. Bradley, Clyde C. Dawson, Alfred Stone, E. T. Meredith, Dwight B. Hoard, Nelson R. Peet,** and **H. C. Van Norman.**

Prof. William Frecheville, a well-known London consulting mining engineer, and former president of the I. M. M., recently made a trip to Queensland, Australia, and spent eight days in the newly discovered Mount Isa silver-lead field, in the northern part of that state. He said on his return from the district, that the Mount Isa region contained a remarkable showing of silver-lead on the surface, and of a new type to him. He had not only never seen anything like it himself, but had not heard of a similar deposit. On pages 165 to 171 of this issue of *Mining Journal-Press,* the Mount Isa district is described by A. W. Newberry, mining engineer of New York.

Obituary

Oscar Newhouse, former associate with John Treadwell in Alaskan mining enterprise, died in New York on July 13, 1924. He was born in California sixty-three years ago, practiced mining on the Coast and went to Alaska before the gold rush, at one time controlling the electric light and telephone system of Dawson. He is survived by a widow and daughter.

William Pritchard Morgan, at one time a member of the British Parliament, died recently in England. Mr. Morgan took a leading part in endeavoring to exploit the gold deposits of Wales. While gold was found—royal wedding rings have of late years been made from it—the reefs were not sufficiently rich to earn any return upon the capital invested. Pritchard Morgan, who was in his eightieth year, at one time was interested, also, in mining in Australia and in his later years took an active part in concessions in China.

Daniel Lunt Cleaves, superintendent of the Balbach Smelting & Refining Co., at Newark, N. J., was instantly killed by a motor truck at the plant on July 25, 1924. Mr. Cleaves, who was a well-known metallurgist, was born in Kennebunkport, Maine, on March 19, 1881. He was a graduate of University of Maine, and of the Massachusetts Institute of Technology. For thirteen years he was associated with the St. Joseph Lead Co., at Herculaneum, Mo., and for the last five years he has been superintendent of the Balbach S. & R. Co. Mr. Cleaves was a Mason, a member of the Delta Kappa Epsilon Fraternity, also a member of the A. I. M. E. Besides a widow he leaves a daughter. Services were held at his late home, and burial was in Lenox, Mass.

Charles Ferris Sturtevant

As previously reported in our issue of June 15, Charles Ferris Sturtevant, superintendent of the Cia. Minera de Palmarito, was murdered in the company's mine, six miles from Mocorito, Sinaloa, Mexico, on June 4. He was born in Cleveland, Ohio, on Feb. 3, 1870, being a descendant of Samuel Sturtevant, who came to America from England in 1642 and settled at Plymouth, Mass. He was educated at St. Paul's School, Concord, N. H., taking mechanical engineering. After a preliminary engagement with the Union Pacific company, 1891-94, he followed the profession of a mining engineer in various parts of the world. In 1895 he was in the Cœur d'Alenes; in 1896, in British Columbia, at the Trail smelter. He was appointed metallurgical clerk at the Northfield (Wash.) smelter in 1898, afterward occupying a similar post at the F. A. Heinze smelter at Butte.

In 1900 Mr. Sturtevant took a special course in metallurgy and surveying at the Michigan College of Mines, returning to Butte in 1901 to become assistant superintendent of the plant at which he was formerly metallurgical clerk. Ill health supervened in 1904, when he was superintendent of the Yampa smelter at Bingham, Utah, after which he went to Cooke, Mont., to supervise the operations of a mining enterprise in which he had become personally interested.

Subsequently, he held a position with the Great Cobar Copper Co., in New South Wales, Australia; and from 1908 until 1915 he was in Mexico, as superintendent of various properties. Followed examination work for the General Exploration Co. at Lark, Utah, and later he was connected with the Bingham Central Railroad Co. In 1919-20 he was assistant manager for the Mineral Hill Copper Co., at Tucson, Ariz., leaving to carry out professional work for the Barnsdall Corporation, in Bolivia and British Columbia. He became superintendent for the Palmarito company in February, 1923. He married, in 1917, Miss Sophie Brodbeck, daughter of Dr. Adolf Brodbeck. He is survived by his wife and a sister.

Charles Ferris Sturtevant

Recent Technical Publications

Reviews, Abstracts, and References

Economics of Petroleum

Valuation of Oil and Gas Lands. By Robert Wesley Brown. The McGraw-Hill Book Co., New York. Price $3.

The author of this book has taken a subject that is constantly in the minds of all oil men. The mention of a new theory of the origin of salt domes acts like a tonic in a meeting of geologists; a new method of cementing stirs the interest of production engineers; and the description of a recent innovation in cracking draws questions from the refinery men. But not one of these subjects can hold the interest of all. Lawyers, geologists, engineers, refiners, operators, and investors all find a common ground in the subject of Mr. Brown's book—valuation.

It is true that the author limits himself to the title "Valuation of Oil and Gas Lands," by which one would understand the valuation of oil-producing properties. This is a subject of greater importance than the valuation of transporting, refining, and marketing properties. In it are found practically all of the factors which go to determine values in the other phases. In addition, its problems are more difficult and at the same time of greater interest and subject to greater difference of opinion.

To an outsider it would seem to be a comparatively simple thing to assign a value to a producing or prospective property. However, when one considers the recent development of the oil business and the uncertainty of its future, one cannot help feeling that the oil man is often working in the dark. If the price of copper declines, mines are shut down without detriment to their owners except in lost dividends during the period of low prices. In the oil business it is rarely possible to shut down, because of competitive drilling and production. Thus millions of barrels of oil may be thrown on an already heavy market.

The value of a barrel of oil varies from point to point, and oils produced in the same pool bring widely different prices, because of differences in chemical nature. The varying costs of production and the element of chance entering into all field work are too well known to require special mention. A successful treatment must include the application of geological and engineering principles and practice, of accounting rules, taxation and production laws, and a general background of economics.

Mr. Brown's book contains somewhat more than 200 pages, divided into eleven chapters and an appendix. The latter is worthy of special mention because of the completeness of the tables, which are in constant demand wherever valuation work is being done. With the exception of the last chapter, which is devoted to the valuation of gas lands, the rest of the book is closely knit together. I cannot help feeling that the author might well have omitted the chapter on gas. A general chapter seems out of place in a volume whose value lies in specific information.

The ten chapters devoted to the discussion of oil properties are taken up in logical order, starting with a chapter on definitions and reasons for the determination of value and ending with one dealing with valuation under the Federal Income Tax Law. The second chapter deals with what might be called the mechanics of estimation of the action of producing wells. The difference between the several methods and their relative importance as guides is very clearly brought out. The one following deals with estimates on undeveloped tracts. The subject matter is necessarily largely theoretical.

One of the longest and most important chapters in the book is that devoted to the price of petroleum. Yet the chapter is weak through lack of proof of many of the general statements. One receives so general an outline of the nature of petroleum and its products that one is likely to be misled. Barely a page is given to the important question of the ultimate supply of oil in this country. Much the same might be said of the chapter on costs. I agree with the author that cost data are of little value unless exact conditions of drilling are given, but I am of the opinion that many of the results of experience would be of sufficient interest and value to those who may be interested in drilling to make their inclusion desirable.

The chapters covering the application of the principles of valuation to the actual problems of depletion, depreciation, valuation, and taxation met from day to day by the oil man are well worked out and ably present this side to the reader. The chapter entitled "Methods of Valuation" is particularly interesting because of the number of problems that are presented and solved.

To give a fair estimate of Mr. Brown's book is a difficult task. As a guide to those who are actually involved in the work of valuation it will be of considerable value. Those who are not in close touch with such work will, I fear, find the book lacking in detail. However, when one considers the scanty and unreliable nature of the material that has been published in this field one is inclined to congratulate Mr. Brown on what he has been able to do and forget what he has left undone.

ERNEST R. LILLEY.

Texas Geology—The U. S. Geological Survey, Washington, D. C., has published Professional Paper 126 "Geology of the Coastal Plain of Texas, West of Brazos River," by Alexander Deussen (pp. 139; obtainable on request, or from the Superintendent of Documents, Washington, D. C., for 40c.)

Congo Diamonds—The March and April issues of the *Journal* of the American-Belgian Chamber of Commerce in Belgium (46, rue de Naples, Brussels) contain a 4-page article on "The Diamond Fields of the Kasai Basin (Belgian Congo)." It discusses the discovery, development, and economic conditions of the industry.

Silica Refractories — Pennsylvania produces about three-fourths of the silica brick manufactured in the United States, and almost all of it comes from one geological formation known as the Tuscarora quartzite, or Medina quartzite. Areas which have been sold for taxes have produced millions of silica brick, and the reserves of this rock for future development are exceedingly large. "The Silica Refractories of Pennsylvania," a book of 100 pages prepared by E. S. Moore and T. G. Taylor, describes the geology of the region, methods of mining and preparing the raw material, and the method of manufacturing the brick, all in considerable detail. Apparently there is a free interchange of technical information among the various refractory companies represented there. The book will be of interest to all those possessing similar deposits of quartzite as well as to refractory manufacturers and users, and is a highly creditable effort. Copies may be obtained on request from the State Geologist, Harrisburg, Pa.

Mining and Smelting in British Columbia—In the June Bulletin of the Canadian Institute of Mining and Metallurgy (603 Drummond Building, Montreal; price 50c.), is a 65-page paper by the staff of the Consolidated Mining & Smelting Co. entitled "The Development of the Sullivan Mine and Processes for the Treatment of Its Ores." The paper is unusually complete and interesting. It contains an outline of the history of the Sullivan mine; some account of the methods by which the complex lead-zinc-iron ore has been treated in efforts to solve the metallurgical problems; and an outline of the present mining and metallurgical practice, including a description of the Kimberley plant and the smelter and refineries at Trail. As is generally known, the Betts process is used here for the production of electrolytic lead. The management of the Consolidated deserves credit for releasing so much practical information regarding the staff's interesting work.

Rock Dust—"Preventing the Creation of Fine (or Phthisis Producing) Dust When Drilling Rock With Air-operated Machine Drills of 'Leyner' Type" is the subject of an illustrated 16-page paper by J. H. Veasey in the *Journal* of the South African Institution of Engineers for May (Johannesburg; price 2s.).

Manhattan District, Nevada — Bulletin 723 of the U. S. Geological Survey, Washington, D. C., 163 pages, obtainable on request, is entitled "Geology and Ore Deposits of the Manhattan District, Nevada," and is by Henry G. Ferguson. This region is about 35 miles north of Tonopah. The bulletin describes in a general way the geology of the district, with separate discussions of the various mines, and is well illustrated with maps and photographs.

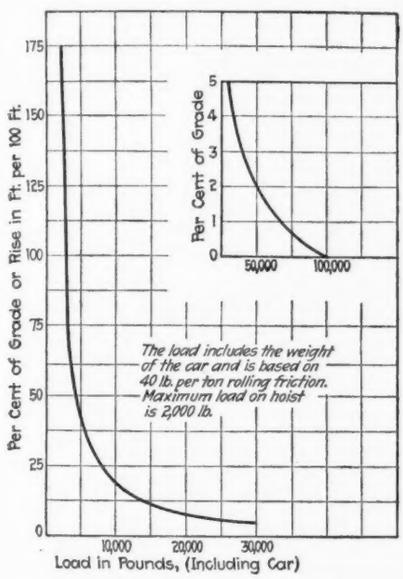
Flotation of Gold—The April Bulletin of the Institution of Mining and Metallurgy (Cleveland House, 225, City Road, London, E. C. 1, England) contains 36 pages of further contributed remarks on the paper by R. J. Lemmon, "The Concentration of Gold-copper Ores by Froth Flotation at Tul Mi Chung."

New Machinery and Inventions

Portable Electric Hoists for Ore Scraping

Portable hoists, both single and double drum, with compressed air motors, have proved very popular for mining, contracting and miscellaneous industrial service, according to information which the Sullivan Machinery Co. recently made public. Under certain conditions, however, there has been a demand for an electric portable hoist of similar character, which could be employed when electric wires were strung to the work to be done, or when compressed air was not available.

To meet this requirement, single-drum and double-drum electric portable hoists have been designed by the Sullivan Machinery Co., and are now in successful use in different parts of the country. As shown by the accompanying illustrations, they are quite



Haulage curve indicating loads which hoist will handle on different grades

similar in appearance to the compressed-air machine. As in the air hoist, the motor of the electric machine is contained entirely within the drum.

In the single-drum hoist, the motor is supported at one end of the frame or base, and supplies power, through reduction gears to the hoisting drum, which is 11¾ in. in diameter by 8¼ in. long. This relatively large drum diameter reduces strain and wear on the hoisting rope, which is $\frac{5}{16}$-in. wire cable. The drum holds 500 ft.

The horsepower and rating of the hoists are similar to those of the compressed-air machine—namely, 6½ hp. with a capacity of 2,000 lb. dead load vertically, at a speed of 110 ft. per minute on single lines. When hauling cars, for example, on moderate grades or on the level, the pulling power is much greater. The accompanying curve sheet shows the ability of the hoist in this direction, and applies to both the single- and double-drum machines.

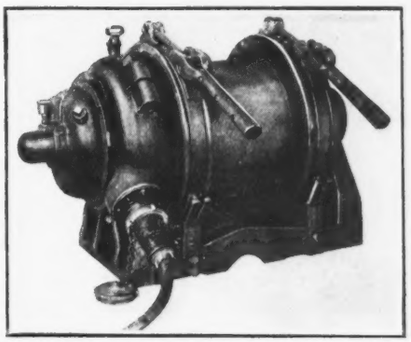
For example, the Steubenville Coal & Mining Co., Steubenville, Ohio, which is using one of the single-drum hoists to pull trips of loaded cars into the bottom as a relief measure for the haulage motor, reports that trips of forty cars with a gross weight of 96,000 lb. are handled perfectly. The grade averaged about 1½ per cent and was on a slight curve. In this case the hoist was bolted to timbers between the tracks, but the location or position of the hoist has no effect on its operation. It may be mounted on a crossbar or column in a shaft winze, or raise for handling drill steel or timbers; bolted to a timber or a girder, or to a tree, or to a wall or floor, for pulling cars, piling lumber, or odd jobs of hoisting and hauling.

It is adapted for numerous uses in metal and coal mines, quarries, on construction jobs and in material-handling yards of many sorts. The single-drum hoist weighs 480 lb.

Double Drum Hoist for Slushing

For ore scraping or slushing work, the double-drum Sullivan electric hoist has been in use for over a year, with excellent satisfaction, in the Lake Superior country. The illustration shows an installation of one of these machines in the Montreal Mining Co. at Hurley, Wis., on an ore-slushing table or slide for handling ore into cars, in drifts. This machine weighs 770 lb., is 38 in. long by 15 in. wide, and stands 19 in. high.

In the double-drum hoist the electric motor is mounted between the two drums on a central standard, carrying a pinion at each end of its armature shaft, and thus furnishing power through reduction gears, to the two drums, each of which is 11¾ in. in diameter by 6¼ in. in length, with a capacity



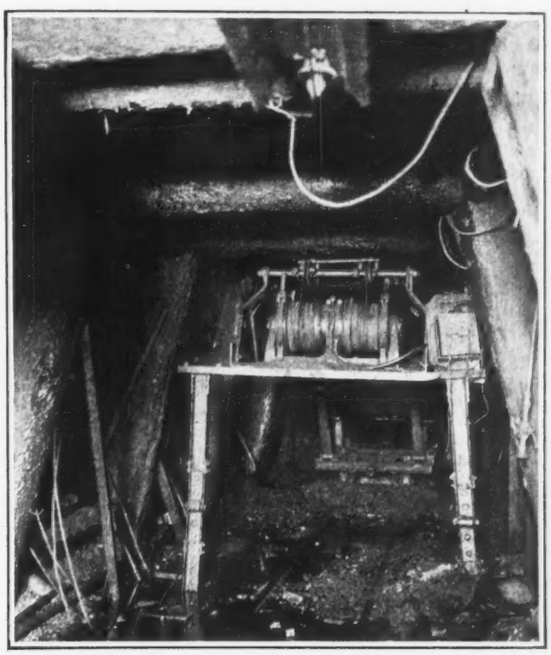
Single-drum electric portable hoist

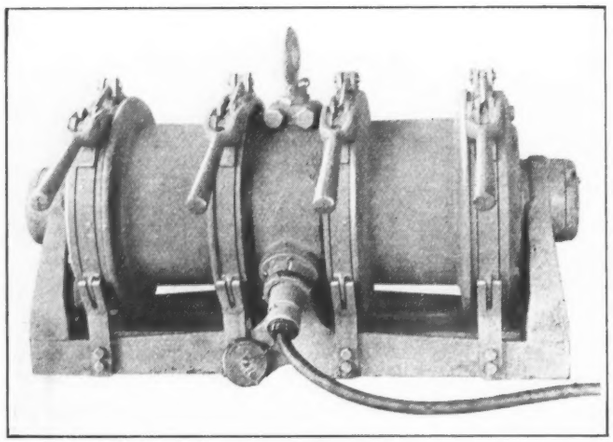
of 250 ft. each of $\frac{5}{16}$ in. wire rope. The right-hand or haulage drum has an operating speed at full load (2,000 lb. vertical lift) of 110 ft. per minute. The gearing of the left hand or tail rope drum provides for 160 ft. per minute for handling the empty scraper or drag line.

These electric slushers have given exceedingly satisfactory service, equal in all respects to that furnished by the compressed-air portable hoist, under conditions where air power is not available.

The 6½-hp. motor, built especially for this hoist by one of the leading manufacturers, draws about twenty-five amperes when running the hoist at full capacity. It is a compound-wound motor with series winding. It is totally inclosed, so that dust and dirt are excluded. The temperature rating is ten minutes full load, with a 55-deg. centigrade rise. The motor will run continuously at no load without overheating. The above ten-minute period, of course, is longer than any during which the hoist will be called upon to deliver its full load rating under any ordinary conditions. The armature revolves on ball bearings, lubricated by a splash system inside the drum, which also lubricates the reduction gears and their bearings. The

Double drum electric hoist installed at Montreal Mining Co., Hurley, Wisconsin, for "slushing" iron ore. This hoist has been in use for over a year. The frame shown above it is a guide for the rope.





View of double-drum electric hoist, showing drums removed and location and mounting of the motor

motor heads are especially designed to prevent oil from leaking into the motor. The motor head may be removed without disturbing the wiring to the brushes.

A damp-proof electric plug and receptacle, with 10 ft. of heavy rubber covered cable, are furnished to connect the hoist to the starting box. The receptacle is fastened centrally on the frame, and the motor leads connecting with it are totally inclosed. The starting box is of substantial and compact form, and may be hung on a spike or at any convenient point near the hoist. Its insulating tubes are inclosed in a sheet-iron box, and are moisture-proof. The front of the box is of slate, and contact buttons are protected by a safety cover. A fuse block and two thirty-ampere fuses are provided. This part of the outfit is light and portable, and may easily be disconnected from the hoist.

Transmission

The operating parts of the hoist embody the experience of the designers in the air machines. The reduction gears are of especially large dimensions, to withstand the severe duty required in portable hoist service, particularly in ore scraping. These gears are cut from alloy steel and are properly heat-treated. They revolve on ball bearings. The internal mechanism of the drum also rotates on ball or roller bearings. Electric steel castings and drop forgings have been employed for almost all parts of these machines, thus permitting light weight without sacrifice of rugged strength.

Portable Electric Instruments of Special Type

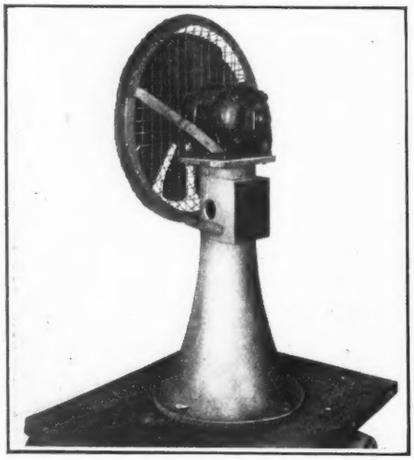
Special portable thermo-type voltmeters and milliammeters are now being made by the General Electric Co. Important applications of these are the measurement of high frequency circuits of moderately low capacity and also low voltage alternating-current measurements of ordinary frequencies. The D'Arsonval instrument element is used, mounted in a standard case. This element is actuated, however, from a vacuum thermocouple, located inside the carrying case, thus making the instrument self-contained.

Voltmeters are being made in ranges from 0.75 to 150 volts, and milliammeters can be built for either 20, 25 or 30 milliamperes. The voltmeters are designed to stand loads of 25 to 50 per cent in excess of the normal ratings. All the instruments are highly damped. The resistance of the voltmeters is approximately 40 ohms per volt.

A Fan for Making Hot Work Cooler

Workers in foundries, drop forge shops, and other places where the heat is intensive will be interested in a new man-cooler fan developed by the Buffalo Forge Co., of Buffalo, N. Y. This unit is made in two sizes, the larger having a 36-in. diameter fan wheel, and the smaller a 30-in wheel. The entire fan is of heavy construction to insure against vibration. The screen inclosing the fan wheel is extra heavy, while the rim itself is made of 2¼ x 2¼ angle. The unit, however, can be moved easily.

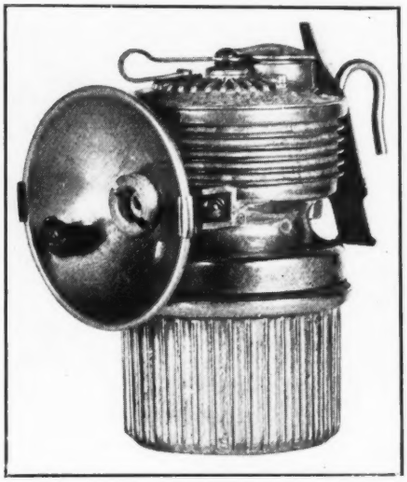
This fan consists of only three essential parts—the fan wheel, a direct-connected motor, and the pedestal. The wheel is composed of ten blades so designed that the air is delivered in a concentrated solid stream. This factor of air delivery is important here, in order that the best cooling efficiencies at the lowest expenditure of power may be had. A direct-connected motor placed directly back of the fan wheel supplies the motive power. The 36-in. man-cooler fan is supplied with a 5-hp. motor, and the smaller fan is equipped with a 3-hp. unit. The speed for fans is 900 r.p.m. The pedestal is a heavy casting: four bosses are provided in the base for foundation bolts in case the unit is maintained in a permanent location.



A fan for cooling men working at forges and in other hot places

Miner's Lamp Made of Aluminum

A new acetylene miner's lamp is made of cast aluminum, with walls ⅛ in. thick and seamless. The water tank and carbide cup are ribbed, as may be seen in the accompanying illustration. This feature adds strength and permits a firm grip for unscrewing the cup. Construction is simple and the lamp can be taken completely apart and put together again in a few minutes. Every part in it is replaceable. In spite of its solid metal walls and great strength, it weighs less than brass lamps of the same size. The new lamp is made by the Fred R. Belt Co., Inc., 355-361 W. Ontario St., Chicago, Ill., and is known as the "Lu-mi-num" lamp.



All parts in this aluminum miner's lamp are replaceable

Trade Catalogs

Fire Pumps — Single-stage underwriters' fire pumps, as specified and approved by the Associated Factory Mutual Fire Insurance Co. and by the Underwriters' Laboratories, of Chicago, are described in a four page leaflet issued by the De Laval Steam Turbine Co., of Trenton, N. J.

Cement and Stone Industries. Catalog No. 397, featuring equipment for the cement, stone, and allied industries, has been prepared by the Jeffrey Manufacturing Co., Columbus, Ohio. It shows the wide variety and application of chains and attachments, sprocket wheels, conveyors, elevators, pulverizers, crushers, lime-grinding plants, manganoid balls and linings for tube-mill service, portable loaders, portable bag stackers and other like paraphernalia.

Speed Reducers. In Catalog 26 the W. A. Jones Foundry & Machine Co., Chicago, devotes 96 pages to data and illustrations of its spur-gear speed reducers.

Pulleys. Catalog 27 of the W. A. Jones Foundry & Machine Co., Chicago, 48 pages, describes the company's line of pulleys of cast iron, steel, paper, and wood.

The Market Report

Daily Prices of Metals

July	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
24	12.625@12.75	48.25	48 75	7.25	7.10@7.25	5.05@5.075
25	12.75@12.875	48.25	48.75	7.30	7.125–7.375	6.05
26	12 875	48 00	48.50	7.30	7.15@7.375	6.05
28	12.875@13.00	47.75	48.25	7.30	7.25@7.40	6.05
29	12.875@13.00	47.875	48.375	7.50	7.35@7.40	6.05
30	12.875	48.75	49.25	7.55	7.40	6.025
Av.	12.854	48.146	48.646	7.367	7.298	6.048

*These prices correspond to the following quotations for copper delivered: July 24th, 12.875c.@13.00c.; 25th, 13.00c.@13.125c.; 26th, 13.125c.; 28th and 29th, 13.125c.@13.25c.; 30th, 13.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

July	Copper			Tin		Lead		Zinc	
	Standard		Electro-lytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
24	62½	63½	66¾	243¾	244	33½	32	32¾	32⅝
25	62⅝	63⅞	67¼	245	245	33⅜	31¾	32⅝	32½
28	63½	64½	68	244⅜	244⅜	33½	32⅛	33	32¾
29	63¼	64¼	68	242¼	242½	33¾	32	32¾	32½
30	63⅛	64⅛	67½	246¼	246¼	34	32	32½	32⅜

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
24	4 39¾	67¾	34 7/16	94s ..	28	4.39	68⅛	34⅝	94s ..
25	4.39⅞	68	34⅝	93s 9d	29	4.39⅛	68¼	34¾	94s ..
26	4.39¾	68⅛	34⅝	.....	30	4.39⅜	68	34 11/16	93s11d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Improvement of Metal Market, Zinc Excepted, Continues

New York, July 30, 1924.—With the exception of zinc, the week has been one of improving metal prices. The volume of sales made in all the metals has been good, but especially so in copper and lead, both of which continued the advance noted last week. Although July is normally considered a rather dull month, the present one seems to be an exception. As usual, the behavior of the London market has had a strong influence on domestic prices. Both markets have responded to increased demand from consumers. Silver registered a new high for the year yesterday.

Copper Displays Further Strength

In a rapidly advancing market, sales are often concluded each day at varying levels. The past seven days bear this out. Last Thursday copper was sold as low as 12⅞c. delivered and as high as 13⅛c. in the Middle West. Every day since then the range between the high and low for the day has been about one-eighth cent. The high for the week where normal freight rates were concerned was 13⅛c. per lb. delivered, a figure that was obtained last Monday and Tuesday. Today, owing chiefly to the decline in the London market, copper is easier, and can be procured for 13⅛c. in fair tonnages. Consumers have not been so anxious to buy the metal today as at other times during the week. Speculative interests have been active in the market. The volume of business done has been satisfactory to nearly all producers. Some of them have been contented with a good export market and have not sold much copper to domestic consumers. Others have booked heavy tonnages in both markets. The demand has been fine and the price about on a parity with the domestic level. The copper producers feel that the acceptance of the Dawes report in Europe is a foregone conclusion, because of the seriousness of the situation, and that this fact, coupled with the greater purchasing power of the farmers on account of higher prices for agricultural products, will have a stimulating effect upon the copper market. One thing is sure, the situation does not look so dark as it appeared three to four weeks ago.

Lead Prices Largely Nominal

The official contract price for lead of the American Smelting & Refining Co. was advanced from 7.25 to 7.50c., New York, on Tuesday, July 29.

Producers were flooded with inquiries and orders from Thursday to Monday, but with the advance in price by the A. S. & R. company yesterday, there seems to have been a marked falling off in interest. As was true before the recent slump in prices, producers are unwilling to sell freely at their quoted prices. They have ample supplies of lead, accumulated during the last two months, as a rule, but in an advancing market prefer to feed it out gradually. Even their regular consumers are not allotted as much as they would like to have, and dealers have often been compelled to pay fancy prices when they were able to obtain the metal at all. For instance, on Thursday, Friday, and Saturday, when producers were selling to consumers at around 7¼c., St. Louis, dealers were compelled to pay 7⅜c. Large lots were sold at both levels. Today the range is 7⅜c., St. Louis, and 7½c., New York, for limited tonnages to consumers, and 7½c., St. Louis, and 7⅝c., New York to dealers.

No great improvement in orders for finished lead materials is yet apparent, nor has it been expected much before the first of September. The sudden demand is largely a speculative one. Dealers are anxious to lay in modest stocks in anticipation of a good fall business with higher prices, and consumers have decided that the time is also opportune to buy a little further ahead than usual. Representatives of prominent storage-battery, paint, and lead-covered cable interests, when interviewed today, stated that there had

been no sudden increase in their business to warrant the advance. Lead production has probably fallen off little from the peak reached in April, but the European demand is so strong that all supplies are quickly absorbed. The price here would have to go up at least another half cent before any Mexican lead could come into this country, even in ore.

Zinc Quiet Around 6c.

Galvanizers have shown little interest in the zinc market this week, and only small tonnages have been sold for domestic consumption. Several export orders have been booked, but the tonnage so disposed of has not been so great as last week. On most of this business, 6.15c. has been realized at Gulf ports. Inasmuch as ore prices were advanced to $40, and in the last three days to $41, smelters are not anxious to cut prices below the 6c. level. Bids of 6c. were made today, but the general asking level was 6.05c., at which most of the business during the week was done. Most of this metal was for August delivery. High-grade sold for 8@8¼c., delivered in the East.

Tin Scarce in Dull Market

Another week of inactivity in the tin market, with fully maintained prices, has gone by. The London holders of the supplies do not yet appear impatient in waiting for the American demand to assert itself. So far, consumers here have bought only occasionally in small amounts. Dealers were somewhat more active on Monday and Tuesday at the slightly reduced prices, but today the market got back up to 49¼c. for spot Straits.

Arrivals of tin to July 29 total 4,717 long tons according to the New York Metal Exchange.

New York Silver Higher Than London Parity

The New York market advanced steadily until July 30, when a decline in the Indian bazaar rates, together with sales from China in London, caused a slight reaction. Local prices continue at a higher level than the London parity.

Mexican Dollars—July 24th, 52⅛c.; 25th, 52¼c.; 26th, 52⅜c.; 28th, 52⅜c.; 29th, 52⅛c.; 30th, 52¼c.

Canadian Dollars at New High

Sterling has been practically unchanged around $4.39@$4.40 all week, but francs have slipped a little. Closing cable quotations on Tuesday, July 28, were 5.075c. for francs and 4.3325c. for lire. Canadian dollars continued to advance and the discount is now only ¼ per cent.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 26½@27c. London, £125 per long ton.

Antimony—Per lb.:
Chinese brands, 8⅜c.
W. C. C. brand, 10½c.
Cookson's "C" grade, 11½@11⅝c.
Chinese needle, lump, nominal, 8½@9c.
Better consuming interest.

Bismuth—$2.40 per lb. London, 10s.

Cadmium—60c. per lb. London, 2s. 9d.

Cobalt—2.50@$3 per lb. for spot.

Iridium—$260@$270 per oz.

Iridium alloyed with platinum, $280 @$286.

Nickel—27c. per lb. for 99 per cent virgin metal. London, £135 long ton.

Osmiridium—Crude, $58.50 per oz.

Osmium—$95@$104 per oz.

Palladium—$78@$83 per oz. Crude, $60 per oz.

Platinum:
Refined, $120 per oz.
Crude, $114@$114.50.
Market quiet.

Quicksilver—$71 per 75-lb. flask. San Francisco wires $70.10; London, £13.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

The prices of Germanium Oxide, Magnesium, Molybdenum, Monel Metal, Radium, Selenium, Tellurium, Thallium, Tungsten and Zirconium are unchanged from the prices given in the July 5 issue.

Metallic Ores

Chrome — $19@$22, depending upon grade and source. Nominal.

Manganese—42@46c. per long ton unit, seaport, c.i.f. Nominal.

Molybdenum—80c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $9@$9.25.
High-grade scheelite, $9.25.
Ordinary grades, $8.50@$8.75. Nominal.

Iron Ore, Magnetite, Tantalum, and Vanadium are unchanged from July 5 quotations.

Zinc and Lead Ores Higher

Joplin, Mo., July 26, 1924 — Zinc blende, per ton, high, $42.15; basis 60 per cent zinc, premium, $41@$42; Prime Western, $40@$41; fines and slimes, $40@$38; average settling price, all grades of blende, $38.49 per ton.

Lead, high, $86.40; basis, 80 per cent lead, $85 bid, $90 asked; average settling price, all lead ore, $84.65 per ton.

Shipments for the week: Blende, 12,455; lead, 1,260 tons. Value, all ores the week, $486,090.

Shipments for the year: Blende, 397,813; calamine, 372; lead, 49,679 tons. Value, all ores seven months, $21,279,590.

Demand for blende, desultory for many weeks, was aroused last week with a purchase of 13,600 tons, followed with a purchase of 20,000 tons this week, resulting in a general advance in price of $1 to $2 per ton more than two weeks ago.

Sellers are slow to accept present lead prices, and a considerable tonnage is held for a higher market. Buyers were offering $85 basis this week, but some sellers held for $90.

Platteville, Wis., July 26, 1924 — Blende, basis 60 per cent zinc, $42.50@ $43 per ton. Lead, basis 80 per cent lead, $85 per ton. Shipments for the week: Blende, 945 tons; lead, none. Shipments for the year: Blende, 17,114; lead 652 tons. Shipments for the week to separating plants, 1,579 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Beryl, Borax, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli and Zircon are unchanged from July 5 prices.

Mineral Products

Arsenious Oxide (white arsenic)—7⅞c. per lb. Demand fair.

Copper Sulphate—4.50c. per lb. for domestic in carload lots. Imported at marked concessions.

Potassium Sulphate, Sodium Sulphate, Sodium Nitrate and Zinc Oxide are unchanged from July 5 prices.

Ferro-Alloys

Ferromanganese—Reduced to $105 per gross ton.

Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices given in the July 5 issue.

Metal Products

Copper — Sheets, 20⅛c. base; wire, 15¼c.

Lead Sheets—Cut, 11c.; full, 10⅞c. per lb.

Nickel Silver—18 per cent Grade A sheets, 26¼c.

Yellow Metal — Dimension sheets, 17⅞c.; rods, 14⅞c.

Zinc Sheets—Base price, $9.50 per 100 lb., f.o.b. plant.

Refractories

Firebrick — First quality, $40@$43 per M., Ohio, Kentucky, and Pennsylvania works; second quality, $33@$38.

Silica Brick—$36@$38 per M., Pennsylvania; $48, Alabama.

Bauxite Brick, Chrome Brick, Magnesite Brick, Magnesite Cement, and Zirkite are unchanged from July 5 prices.

Iron Trade Dull and Unchanged

Pittsburgh, July 29, 1924.—There has been just a perceptible increase in the volume of steel buying since the middle of July to be noticeable. Mill operations have not dropped to as low a level as many expected. The average for July will probably prove distinctly above 40 per cent, and may be 45 per cent.

Steel prices remain in the declining stage. Three lines, rails, pipe and tin plate, have not declined at all from the level of last year.

Pig Iron.—The market is very dull as to turnover, but producers seem to be quite firm on prices. Bessemer, $20; basic, $19; foundry, $19, f.o.b., Valley furnaces.

Connellsville Coke.—Market remains dull; furnace, $3; foundry, $4.25@ $4.75; heating, $2.60@$2.75.

Company Reports

Union Minière du Haut-Katanga

The Katanga area of the Belgian Congo was located as a consequence of the enterprise of the Tanganyika Concessions, an English company, originally formed to exploit certain interests in northern Rhodesia. The Tanganyika Concessions obtained from the Congo Free State the mineral rights for a term of years over some 60,000 square miles, the consideration being the payment to the Katanga (Belgian) Special Committee of 60 per cent of the profits. Subsequently the concession was assumed by the Union Minière, under the control of which mining has since been conducted. The Tanganyika Concessions, therefore, has become, so far as operations in the Belgian Congo are concerned, a share-holding company in the Union Minière.

The full potentialities of the concession have by no means yet been exploited, but it is understood that a copper belt about 200 miles long has been traced, on which over 100 copper deposits have been located. There is also a belt containing tin deposits which has been intersected at intervals for a distance of over 100 miles. One gold mine is known, and considerable areas containing iron are reported. One or two coal propositions have been struck, although generally these appear to be of low value and not suitable for smelting.

Some of the copper ores are of very high grade, and for the treatment of these and the concentrated ores seven furnaces are now at work. The larger part of the ore is, however, of medium and low value. At Panda a large concentrating plant has been erected to treat 4,000 tons of low-grade ore per day, while hydro-electric works will be erected at the Lufira Falls, to furnish current for a leaching plant. The output of copper is expected presently to reach 100,000 tons per annum.

The table below shows the results obtained during the last four years. The company appears to be in a position to land copper in Europe at a cost of approximately £50 per ton, a figure which may be reduced when operations are conducted on a still larger scale. The directors state in their report for 1923:

"Notwithstanding unfavorable conditions, thanks to our very low costs of production, we have been able to realize a large profit, and have experienced no difficulty in disposing of our production. In addition to copper, our tin and radium departments have given satisfactory results."

Development work has been actively continued at the Ruashi and Kalabi mines, and the deposits of Lukuni, Kipushi, Chandwe, Kurukuruku and Tantara. At the end of 1923 the mining development work undertaken had proved the existence of reserves of copper ore as follows:

Oxide Ores	Tons	Per Cent Copper	Total Copper Contained
Ore for smelting	4,421,700	18.28	792,000
Ore for concentration	11,080,900	7.62	845,099
Ore for leaching	40,402,700	5.82	2,507,100
Lowgrade ores	3,316,500	2.84	94,200
Sulphide ores	7,665,000	2.97	228,000
Complex ores	5,779,200	5.81	335,700
Total, December, 1923	72,666,000	6.20	4,802,000

The tonnages of copper ore extracted from the various mines were:

Star	197,128 tons	Luushia	38,302 tons	Total 1,307,027 tons
Kambove	747,437 tons	Ruashi	5,782 tons	
Likasi	316,916 tons	Tantara	1,462 tons	

The Panda concentrator treated during 1923 759,451 tons of ore and produced 142,719 tons of concentrates of an average grade of 24.95 per cent copper.

At the Star mine the washing plant treated 57,105 tons of ore, giving 20,417 tons of washed ore at 20.42 per cent copper.

At Lubumbashi the sintering ovens produced 17,826 tons of agglomerate. The water-jacket furnaces treated 339,186 tons of ores, 141,797 tons of limestone fluxes, and 92,184 tons of iron-ore fluxes. The coke consumption was 120,329 tons, and the output of bar copper 56,221 tons.

The test reverberatory furnace produced 735 tons of good quality copper. Some improvements have been considered necessary, and if the results are up to expectations it is proposed to enlarge the plant so as to extend the treatment of the fine concentrates and ores by this process.

The test leaching plant at Panda treated 13,217 tons of ore and produced 1,124 tons of electrolytic copper. The results obtained confirm the estimates, and it is intended to begin the erection of the permanent plant for the treatment of the low-grade ores.

The total production of copper in 1923 was 57,886 tons, and for the six months from January to June, 1924, 36,531 tons. The plans have now been completed for the hydro-electric installation at the Lufira works, and also of the plant to treat the low-grade ores by the leaching process.

The Busanga tin mine produced 705 tons of cassiterite in 1923. The total quantity of tin recovered since the beginning of operations amounted at end of December, 1923, to 2,354 tons. A plant consisting of three electric furnaces has been built at Panda, and started work in May, 1924. These furnaces produce an alloy of copper-cobalt-iron, which is being shipped to Belgium and treated there according to a method devised and improved by the Hoboken Metallurgical Co.

The working of the Chinkolobwe deposit (uranium-radium) has been continued. and a large quantity of ore has been shipped, which is being treated at the Oolen works.

The company holds shares of the nominal value of 10,000,000 francs in the Katanga Railway, and a controlling interest in the Société Générale Metallurgique de Hoboken, which undertaking is mainly interested in the treatment of the various ores from the concession.

The capital statement is as follows: 260,000 dividend shares without par value; 260,000 capital shares of 100 fr. and 100,000 preference shares of 500 fr.

Four and one-half per cent debentures, 20,000,000 fr.; 7 per cent debentures, 40,000,000 fr.

Year	Copper, Tons	Mining Profits, Fr.	Mining Profits per Ton Fr.	Other Receipts Fr.	Total Revenue Fr.	Interest &c. Fr.
1920	18,962	14,622,165	770	1,117,881	15,740,047	5,755,661
1921	30,461	9,510,241	312	393,804	9,904,045	3,700,000
1922	43,562	47,915,618	1,105	143,468	48,059,087	6,700,000
1923	57,886	78,872,755	1,362	.....	78,872,755	6,700,000

Depreciation Fr.	Net Profit Fr.	Dividends Ordinary Fr.	Dividends Preference Fr.	Ore Reserves Tons	Ore Reserves Copper Contents, Tons
9,984,386	.....	.....	..	32,300,000	1,869,500
6,204,045 (a)	.....	.....	..	46,348,000	2,812,000
21,158,470	20,200,617	35 (32.20 net)	30 net	68,500,000	4,515,000
21,141,125	51,031,630	80 (73.60 net)	30 net	72,666,000	4,802,000

(a) 69,025,706 fr. also transferred from capital account.

Transvaal Gold Output Increases in First Half Year

The output of gold from the mines of the Transvaal during June amounted to 773,053 fine ounces. The output in June last year was 755,309 oz. The following table shows the output for every month since 1918:

	1918 Fine Oz.	1919 Fine Oz.	1920 Fine Oz.	1921 Fine Oz.	1922 Fine Oz.	1923 Fine Oz.	1924 Fine Oz.
January	714,182	676,059	670,503	651,593		764,469	796,768
February	659,759	636,728	625,330	558,137	639,728	704,970	760,617
March	696,281	712,379	707,036	671,123		761,586	795,671
April	717,000	691,944	686,979	681,382	511,338	743,651	768,923
May	741,317	724,995	669,041	687,776	629,786	786,564	809,003
June	727,696	702,379	715,957	678,490	675,697	755,309	773,053
Total (six months)	4,256,235	4,147,484	4,104,846	3,928,501	2,456,549	4,516,549	4,704,035
July	736,199	725,497	736,099	689,555	730,635	754,306	.....
August	740,210	706,669	702,083	711,526	752,490	769,371	.....
September	708,206	698,558	682,173	691,026	747,089	739,504	.....
October	679,764	723,722	662,472	707,825	778,159	793,842	.....
November	658,701	677,970	633,737	704,236	764,476	780,639	.....
December	641,245	650,191	632,215	681,847	790,712	778,849	.....
Total (twelve months)	8,420,560	8,330,091	8,153,625	8,114,516	7,020,110	9,133,060	.....

Mining Stocks

Week Ended July 26, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb			*10		
Anaconda	New York	36¾	36¼	36½	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	2¼	2	2		
Ariz. Com'l.	Boston	12	11	11¼	Jy.19, Jy.31	0.50
Calaveras	N. Y. Curb			1½		
Calumet & Arizona	Boston	53¼	47¾	53¾	Jn. 6, Ju. 23 Q	0.50
Cal. & Hecla (New)	Boston	18¼	17¼	18	My. 31, Jn. 16	0.50
Canario Copper	N. Y. Curb	3⅝	3	3⅛		
Cerro de Pasco	New York	49¼	47	48¾	Ju. 17, Au. 1	1.00
Chile Copper	New York	31⅞	29⅝	31⅛	Se.3, Se.29, Q	0.62½
Chino	New York	20¼	19¼	19½	Sept., 1920,	0.37½
Con. Coppermines	N. Y. Curb	2⅞	2¼	2⅜		
Copper Range	Boston	28½	27	28¼	May, 1923	1.00
Crystal Copper	Boston Curb	*75	*63	*75		
Davis-Daly	Boston	*60	*50	*50	Mar., 1920	0.25
East Butte	Boston	4¼	4⅛	4⅜	Dec., 1919	0.50
First National	Boston Curb	*35	*32	*35	Feb., 1919,	0.15
Franklin	Boston	1	*60	1		
Gadsden Copper	Boston Curb	*90	*70	*90		
Granby Consol.	New York	18¼	16¾	17⅛	May, 1919	1.25
Greene-Cananea	New York	18⅛	14	17⅛	Nov., 1920	0.50
Hancock	Boston	1⅞	1½	1⅝		
Howe Sound	N. Y. Curb	2¾	2⅜	2¾	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	26⅜	25	26¼	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	*4	*3	*4	May, 1923	0.15
Isle Royale	Boston	18⅞	16	18	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	*90	*90	*90		
Jib Consol.	N. Y. Curb	*90	*73	*78		
Kennecott	New York	45½	42	45½	Jn.6, Jy. 1, Q	0.75
Keweenaw	Boston	1	1	1		
Lake Copper	Boston	2⅛	1⅞	2⅛		
Magma Copper	New York	31½	29½	30⅜	Jan., 1919	0.50
Mason Valley	N. Y. Curb	1⅞	1⅜	1⅞		
Mass Consolidated	Boston	1⅛	1	1⅛	Nov., 1917	1.00
Miami Copper	New York	24⅛	22⅞	23¼	Au 1, Au 15, Q	0.50
Mohawk	Boston	36½	31	36	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	8⅜	7⅞	8⅛	Jn.13, Jn.30	0.37½
Nevada Consol.	New York	14⅜	13½	14	Sept., 1920,	0.25
New Cornelia	Boston	22¼	20	21¾	Au.8, Au.25,	0.25
New Dominion	N. Y. Curb			2½		
North Butte	Boston	6⅜	4⅜	6⅛	Oct., 1918,	0.25
Ohio Copper	N. Y. Curb	1⅞	*99	1		
Old Dominion	Boston	27	23	26½	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†105	†99		Jn.21, Jy.2 Q	1.00
Quincy	Boston	24⅞	22⅞	24½	Mar., 1920	1.00
Ray Consolidated	New York	12	11½	11⅜	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	*15	*15	*15		
St. Mary's Min. Ld.	Boston	40	37	37⅜	Ap.22, My.20	3.00
Seneca Copper	New York	2⅜	⅞	2⅛		
Shannon	Boston	*95	*70	*75	Nov., 1917	0.25
Shattuck Arizona	New York	8	6⅛	7⅛	Jan., 1920	0.25
Superior & Boston	Boston	1¼	*85	1¼		
Tenn. C. & C. cfs.	New York	8⅛	7½	8	De.31, Ja.15, Q	0.25
United Verde Ex	N. Y. Curb	27¼	25	26½	Jy.3, Au.1	0.50
Utah Copper	New York	79½	74	79½	Jn.13, Jn.30,	1.00
Utah Metal & T.	Boston	*70	*40	*50	Dec., 1917	0.30
Victoria	Boston	*75	*75	*75		
Walker Mining	N. Y. Curb	3½	3	3⅛		
Winona	Boston	*60	*50	*50		
NICKEL-COPPER						
Internat. Nickel	New York	18⅜	17½	18	Mar., 1919	0.50
Internat. Nickel pfd.	New York	88	87⅜	88	Jy.17, Au.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	3½	3	3		
National Lead	New York	148⅜	145	145½	Se.12, Se.30, Q	2.00
National Lead pfd.	New York	115	114	114½	Au. 22, Se. 15, Q	1.75
St. Joseph Lead	New York	29¾	28¾	29⅛	Se. 9, Se.20	0.50
ZINC						
Am. Z. L. & S.	New York	9⅝	8⅜	9	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	32½	28½	29½	Nov., 1920	1.50
Butte C. & Z.	New York	5⅜	4½	5⅛	Ma., 1923	0.50
Butte & Superior	New York	19⅜	17⅝	18⅝	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	4¼	3⅜	4	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	143	143	143	May 10, 1924	2.00
United Zinc	N. Y. Curb	*25	*25	*25		
Yellow Pine	Los Angeles	70	70	70	June, 1924	0.04
SILVER						
Alvarado	N. Y. Curb	1	1	1		
Beaver Consol.	Toronto	*14½	*14	*14	May, 1920	0.03
Castle-Trethewey	Toronto	*73	*72	*72		
Coniagas	Toronto	1.40	1.25	1.30	Ap.20, My.1	0.02½
Crown Reserve	Toronto	*57	*54	*56	Jan., 1917	0.05
Keeley	Toronto	2.29	2.22	2.28		
Kerr Lake	N. Y. Curb	1⅝	1⅛	1⅛	Ap.1, Ap.15, Q	0.12
La Rose	Toronto	*10	*10	*10	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.40	1.36	1.38		
McKinley-Dar.-Sav.	Toronto	*11½	*10¼	*11	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.45	2.40	2.42	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6⅛	5⅞	5⅞	Jn.30, Jy.21, Q	0.15
Ontario Silver	New York	6¼	6¼	6¼	Jan., 1919	0.50
Temiskaming	Toronto	*21	*19½	*19½	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	⅛	⅛	⅛		
Alaska Juneau	New York	1¼	1⅛	1⅛		
Argonaut	Toronto	*39	*38	*38½		

Stock	Exch.	High	Low	Last		Last Div.
Carson Hill	Boston	1⅛	1	1		
Cresson Consol. G	N. Y. Curb	3⅞	3 11/16	3 11/16	Jn.30, Jy.10, Q	0.10
Dome Mines	New York	16	15¼	16	Jn.26, Jy.21, Q	0.50
Golden Cycle	Colo. Springs	1.30	1.30	1.30	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	14.05	13.90	13.95	Jy.24, Au.11, M	0.05
Homestake Mining	New York	43	42¼	42¼	Jn.20, Jy.25,	0.50
Kirkland Lake	Toronto	*19½	*19	*19½		
Lake Shore	Toronto	3.85	3.75	3.80	My.2, My.15	0.02
McIntyre-Porcupine	New York	15½	15⅛	15½	Au. 1, Se. 1,	0.25
Newray	Toronto	*22	*21½	*21½		
Portland	Colo. Springs	54	51	51	Oct., 1920	0.01
Teck-Hughes	Toronto	1.15	1.13	1.14		
Tom Reed	Los Angeles	32	30	30	Dec., '1919	0.02
Tough-Oakes	Toronto	*58½	*56½	*58		
United Eastern	N. Y. Curb			*47	Jy 18, Jy.31, Q	0.05
Vipond Cons.	Toronto	1.04	*99	1.02		
Wright-Hargreaves	Toronto	3.75	3.50	3.60	Jn.16, Jy. 1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb	*90	*85	*90		
Con. Cortez	N. Y. Curb	*19	*13	*19		
Con. Virginia	San Francisco	3½	2½	3½		
Continental Mines	N. Y. Curb	2½	2¼	2¼		
Dolores Esperanza	N. Y. Curb	*50	*45	*50	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2	1 15/16	1 15/16	Jn.19, Jy.2	0.08
Tonopah Belmont	N. Y. Curb	*55	*50	*55	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*25	*24	*24	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2 1/16	1 15/16	2⅛	Jn. 10, Jy. 1	0.05
Tonopah Mining	N. Y. Curb	2⅛	1 1/16	2	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	1	1	1		
West End Consol.	N. Y. Curb	*52	*35	*52	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	1⅜	*60	*65	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	5¼	5¼	5¼	Jn.16, Jy. 2, X	0.15
Bingham Mines	Boston	17	17	17	Sept., 1919	0.25
Cardiff M. & M.	Salt Lake			*74	Dec., 1920	0.15
Chief Consol.	Boston Curb	2⅜	2⅝	2⅝	Ap 19, My.1, Q	0.10
Columbus Rexall	Salt Lake	15	14½	14½	Aug., 1922	0.03
Consol. M. & S.	Montreal	39⅝	38½	39⅝	Jn.30, Jy.15	0.75
Daly Mining	Salt Lake	2.10	2.10	2.10	July, 1920	0.10
Erupcion	Boston Curb	2½	2⅜	2½	Jn. 16, Jy.2, X	0.15
Federal M. & S.	New York			10½	Jan., 1909	1.50
Federal M. & S. pfd.	New York	47⅞	46	46¼	My.26, Jn.15, Q	1.75
Florence Silver	Spokane	9	8¾	8¾	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	9	8¼	9	My.15, Jn.15,	0.25
Iron Blossom Con.	N. Y. Curb			*20	Oct., 1923	0.02
Marsh Mines	N. Y. Curb			*5	June, 1921	0.02½
Park City	Salt Lake	4.00	4.00	4.00	Jn.14, Jy.1,	0.15
Park Utah	N. Y. Curb			3½	Mc.15, Ap.1	0.15
Prince Consol.	Salt Lake	*6	*5½	*5½	Nov., 1917	0.02
Silver King	N. Y. Curb	*75	*75	*75	Jn.20, Jy.1,	0.15
Silversmith	Spokane	*30	*29	*29	Jy.1, Jy. 10,	0.01
Tamarack-Custer	Spokane	1.50	1.40	1.47	Jn.25, Jn.30,	0.02
Tintic Standard	Salt Lake	5.10	4.70	5.10	Jy.28, '24, X	0.25
Utah-Apex	Boston	†2½	†2¼		June, 1923,	0.50
IRON						
Bethlehem Steel	New York	45	42	43½	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	50	47	50		
Char. Iron pfd.	Detroit			3		
Colorado Fuel & Iron	New York	47	44½	45¾	My.10, My.26	Q 2.00
Col. Fuel & Iron pfd.	New York			102	Feb., 1923	2.00
Gt. North'n Iron Ore	New York	30½	29¾	30	De.10, De.27	2.00
Inland Steel	N. Y. Curb			46	My.15, Jn.1 Q	0.62½
Mesabi Iron	N. Y. Curb			2⅞		
Replogle Steel	New York	13½	11⅞	11¾		
Republic I. & S.	New York	47⅞	45¼	46⅜	May, 1921	1.50
Republic I. & S. pfd.	New York			86½	Se.15, Oc.1, Q	1.75
Sloss-Sheffield S.&I.	New York	62⅛	59¼	62⅛	Jn.6, Jn.20, Q	1.50
Sloss-Shef. S.&I.pfd.	New York	84	84	84	Jn.18, Jy.2, Q	1.75
U. S. Steel	New York	102½	100⅝	101½	Jn.1, Jn.28 QX	1.75
U. S. Steel pfd.	New York	123	122	122⅞	My.6, My.29, Q	1.75
Virginia I. C. & C.	New York	37	37	37	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York			71	Jn.17, Jy.1	2.50
VANADIUM						
Vanadium Corp.	New York	23½	21⅝	23	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*24¼	*23	*23		
ASBESTOS						
Asbestos Corp.	Montreal	24¼	23	24¾	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	59	59	59	Jy.1, Jy.16, Q	1.50
SULPHUR						
Freeport Texas	New York	10⅛	9⅜	10	Nov., 1919,	1.00
Texas Gulf	New York	74½	70¾	74½	My.31, Jn.14 QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅜	3¼	3¼		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	45⅞	43⅜	44¼	My.20, Jn.1, Q	0.75
Amer. Metal pfd.	New York	112	112	112	My.20, Jn.1, Q	1.75
Amer. Sm. & Ref.	New York	70	68	69	Jy.11, Au. 1, Q	1.25
Amer.Sm.&Ref.pfd.	New York	103⅞	102½	103⅞	Au. 8, Se. 1,	1.75
U. S. Sm. R. & M.	New York	31	28	30	Jan., 1921,	0.50
U.S. Sm. R.&M.pfd.	New York	46½	45½	45½	Jy.7, Jy.15 Q	0.87½

* Cents per share † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.